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No. 4 (Transactions, p. 551–654, Abstracts, p. 71–97) published March 30, 1936.

TRANSACTIONS

ABSTRACTS

Abbreviations used in the Abstracts for Titles of Periodicals

Acta Dermat.	Acta Dermatologica
Agr. Hort.	Agriculture and Horticulture
Aichi Igk. Z.	Aichi Igakkwai Zasshi
Ann. Zool. Jap.	Annotationes Zoologicae Japonenses
Berichte des Ohara Inst. f. landw. Forsch.	Berichte des Ohara Instituts für landwirtschaftliche Forschung
Bull. Fish. Exp. Sta., Chosen.	Bulletin of the Fisheries Experiment Station, Chosen
Bull. Imp. Sericul. Exp. Sta.	Bulletin of the Imperial Sericultural Experiment Station
Bull. Miyazaki Coll. Agr.	Bulletin of the Miyazaki College of Agriculture
Bull. Saghalien Centr. Exp. Sta.	Bulletin of the Saghalien Central Experiment Station
Bull. School Fish., Hokkaido Imp. Univ.	Bulletin of the School of Fishery, Hokkaido Imperial University
Chosen Hakub. Z.	Chosen Hakubutsugakkwai Zasshi
Chosen Ig. Z.	Chosen Igakkwai Zasshi
Chosen Ig. Kw. Z.	do.
Chuo Juik. Z.	Chuo Juikwai Zasshi
Dainihon Jibi. Kh.	Dainihon Jibi Kwaihô
Dob. Z.	Dobutsugaku Zasshi
Fukuoka Hakub. Z.	Fukuoka Hakubutsugaku Zasshi
Fukuoka Ikw. Daig. Z.	Fukuoka Ikwa Daigaku Zasshi
Gun-I Dan Z.	Gun-I Dan Zasshi
Hokuetsu Igk. Z.	Hokuetsu Igakkwai Zasshi
Ins. Mats.	Insecta Matsumurana
Jap. J. of Dermat.	Japanese Journal of Dermatology
Jap. Journ. Genetics.	Japanese Journal of Gentics
Jap. Jour. Limnol.	Japanese Journal of Limnology
Jap. Jour. Med. Sci., II. Biochem.	Japanese Journal of Medical Sciences, II. Biochemistry
Jap. Jour. Med. Sci., III. Biophys.	Japanese Journal of Medical Sciences, III. Biophysics
Jap. Journ. Med. Sci., IV. Pharmacology.	Japanese Journal of Medical Sciences, IV. Pharmacology
Jika Z.	Jika Zasshi
Jikken Ganka Z.	Jikken Gankwa Zasshi
Jikken Ig. Z.	Jikken Igaku Zasshi
Jour. Biochem.	Journal of Biochemistry, edited by S. Kakiuchi
Journ. Coll. Agric., Tokyo Imp. Univ.	Journal of the College of Agriculture, Tokyo Imperial University
Jour. Fac. Agr., Hokkaido Imp. Univ.	Journal of the Faculty of Agriculture, Hokkaido Imperial University
Journ. Fac. Sci., Hokkaido Imp. Univ.	Journal of the Faculty of Science, Hokkaido Imperial University
Journ. Imp. Fish Inst.	Journal of the Imperial Fishery Institute
Journ. Sapporo Soc. Agr. & Forest.	Journal of the Sapporo Society of Agriculture and Forestry
Jour. Soc. Trop. Agr. Taihoku Imp. Univ.	Journal of the Society of Tropical Agriculture, Taihoku Imperial University
Juzenkwai Z.	Juzenkwai Zasshi
Kagoshima Kot. Norin. Gak. Hok.	Kagoshima Kôtô Nôrin Gakkô Hôkoku
Kaibô. Z.	Kaibôgaku Zasshi
Keio Ig.	Keio Igaku

Kinki Fujin. Z.	Kinki Fujinkwa Gakkwai Zasshi
Kumamoto Igk. Z.	Kumamoto Igakkwai Zasshi
Kyoto Ig. Z.	Kyoto Igaku Zasshi
Kyoto Ikwadaigaku Z.	Kyoto Ikwadaigaku Zasshi
Manshu Ig. Z.	Manshu Igaku Zasshi
Mem. Coll. Sci., Kyoto Imp. Univ.	Memoirs of the College of Science, Kyoto Imperial University
Mem. Fac. Sci. Agr., Taihoku Imp. Univ.	Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University
Milit. Sci. Lab. Rep.	Military Scientific Laboratory Reports
Nihon Biseibuts. Z.	Nihon Biseibutsu Gakkwai Zasshi
Nihon Gankwa Gk. Z.	Nihon Gankwa Gakawai Zasshi
Nihon Jui Gk. Z.	Nihon Jui Gakkwai Zasshi
Ni. Shokaki Gakkw. Z.	Nippon Shôkaki Gakkwai Zasshi
N. S. Gk. S.	Nihon Suisan Gakkwai Si
Nisshin Ig.	Nisshin Igaku
Okayama Ig. Z.	Okayama Igaku Zasshi
Osaka Igk. Z.	Osaka Igakkwai Zasshi
Proc. Imp. Aca.	Proceedings of the Imperial Academy
Rep. Dep. Agr., Govern. Res. Inst. Formosa.	Reports of the Department of Agriculture, Government Research Institute of Formosa
Rep Hokkaido Agr. Exp. Sta.	Report of the Hokkaido Agricultural Experiment Station
Report Saghalien Centr. Exp. Sta.	Report of the Saghalien Central Experiments Station
Saitô Hô-on Kw. Hak. Zihô.	Saitô Hô-onkwai Hakubutukwan Zihô
Saitô Hô-on Kw. Hak. Zihô Tok.	Saitô Hô-onkwai Hakubutukwan Zihô Tokusyûgô
Saitô Hô-on Kw. Mus. Res. Bull.	Saitô Hô-on Kwai Museum Research Bulletin
Sangyo Sik. Iho.	Sangyô Sikenzyo Ihô
Sci. Rep. Tokyo Bunr. Daig.	Science Reports of the Tokyo Bunrikwa Daigaku
Seiikwai Z.	Seiikwai Zasshi
Shizuoka-ken Agr. Exp. Sta. Bull.	Shizuoka-ken Agricultural Experiment Station Bulletin
S. G. H.	Suisan Gakkwai Hô
S. S. H.	Suisan Sikenzyô Hokoku
Sylvia, For. Inst., Taihoku Imp. Univ.	Sylvia, Forestry Institute, Taihoku Imperial University
Taiwan Ig. Kw. Z.	Taiwan Igakkwai Zasshi
Taiwan Sotok. Chuo Kenk. Nogyob. I.	Taiwan Sôtokufu Chûô Kenkyûsho Nôgyobu Ihô
Tohoku Igk. Z.	Tohoku Igakkwai Zasshi
Tokyo Igk. Z.	Tokyo Igakkwai Zasshi
Tokyo Iji Shsh.	Tokyo Iji Shinshi
Trans. Nat. Hist. Soc. Formosa	Transactions of the Natural History Society of Formosa
Trans. Sapporo Nat. Hist. Soc.	Transactions of the Sapporo Natural History Society
Trans. Tottori Soc. Agr. Sci.	Transactions of the Tottori Society of Agricultural Science

Errata to Vol. VI

Vol. V, No. 3, Transactions, p. 249, 284, 285, 287, 288, 539
for "*choerodonis*" read "*choerodontis*".

" " " p. 251, 252, 412–415, 530–532, 540
for "*chaetodonis*" read "*chaetodontis*"

" " " p. 496 fig. 127, for "Ex. p." read "G. p."

TRANSACTIONS

1. Studies on the Helminth Fauna of Japan
Part 4. Cestodes of Fishes

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CONTENTS

INTRODUCTION

The cestodes of Japanese fishes have not yet been studied on a large scale from the faunistic point of view, though there are rather fragmentary records. Yoshida's paper of 1917 is a notable exception.

The selachian cestodes described in this paper were collected for the most part in April, 1927, at Kuki on the Pacific coast of Mie Prefecture, but the

teleostean materials are from various localities (Inland Sea, Toyama Bay, Lake Biwa, etc.).

It is very interesting to note that the freshwater forms here described are all specifically different from exotic ones, whereas the marine forms from such widely spread fishes as sharks, sunfishes, swordfishes, codfishes, etc, are also widely spread. This relation is best seen in tetrarhynchidean cestodes.

GYROCOTYLIDAE Benham, 1901

1. *Gyrocotyle urna* (Grube et Wagener, 1852)

This species was found in the spiral intestine of *Chimaera ogilbyi* Waite which had been preserved in formol in the Museum of the Seto Marine Biological Station. The worms, more or less strongly crumpled, measure 45 mm in length and 13 mm in maximum breadth behind the middle. The body, flattened dorsoventrally, is concave on the ventral side except the prominent median uterine field. The dorsal as well as the ventral surface of the body is transversely wrinkled and bears deeply imbedded spines, which are more numerous in the anterior part of the body and particularly on the dorsal side. On both sides of the flat conical posterior end of the body there are closely set spines, about 0.2 mm long, as described by Hungerbühler. The acetabulum which consists mainly of radial and circular muscle fibers has no outer limiting membrane. The finely corrugated border of the funnel-shaped anterior extremity partly covers up the papilliform proximal opening of the funnel projecting prominently on the dorsal surface. The lateral edges of the body, greenish grey in color, are coarsely folded except at the two extremities.

Fig. 1

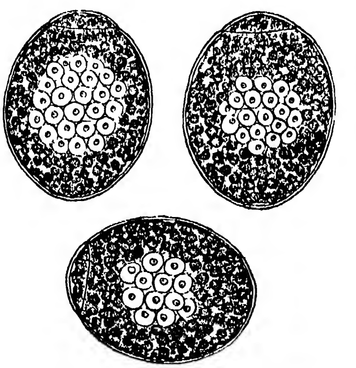

Fig. 1. Eggs of *Gyrocotyle urna*. 87–90×66–69 μ

The papilla-like ventral opening of the cirrus lies slightly to the left of the median line about halfway between the median uterine pore and the posterior end of the body. The vagina opens on the dorsal side near the left margin of the body at the same level as the male aperture. On the internal anatomy of the worm I have nothing to add to Fuhrmann's detailed description. The elliptical, thick-shelled, indistinctly operculate eggs measure in water 0.087–0.09 × 0.066–0.069 mm; the contained ovum is segmented but not yet embryonated. The more elongate young eggs with unsegmented ovum are 0.087 × 0.057–0.066 mm.

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Fuhrmann, O. Gyrocotylidea. Kükenthal's Handbuch der Zoologie, Bd. 2, Teil 2, 1928, p. 161–180.

CYATHOCEPHALIDAE Nybelin, 1922

2. *Spathebothrium simplex* Linton, 1922

This peculiar tapeworm was first reported by Linton from *Liparis liparis*. I also found it in the small intestine of *Crystallias matsushimae* (Jordan et Snyder) from Toyama Bay on June 21, 1928. Here are given some important characters which are missing in Linton's description or erroneously interpreted by him.

As pointed out by Linton, there is no definite layer of inner longitudinal muscles, but a small number of dorsoventral and transverse fibers are present, the latter forming a thin layer between the cellular cortex and the extremely spongious medulla. The calcareous corpuscles are recognizable in the anterior part of the body. Of the excretory system there are two main vessels, one of which passes along each lateral edge of the body between the vitelline follicles and the testes, and the other lies some distance more medially, both being in almost the same frontal plane.

The spherical testes lie continuously in the lateral fields on the inner side of the vitelline follicles and not in front of the ovary. The cirrus pouch with a very thick muscular wall is surrounded by radially arranged prostatic cells, of which the protoplasm is occasionally filled with strongly eosinophil granules. The median opening of the protrusible cirrus lies just in front of the vaginal aperture, indifferently on the dorsal or ventral surface.

The median ovary is situated nearer to the cirrus opening of the succeeding reproductive set than to that of its own and close to one of the flat surfaces of the body without relation to the genital openings as in *Cyathocephalus* Kessler and *Bothrimonus* Duvernoy; its tubular lobes, arranged in a rosette-shaped pattern, extend as far laterally as the testicular field, occupying more than half

Fig. 2

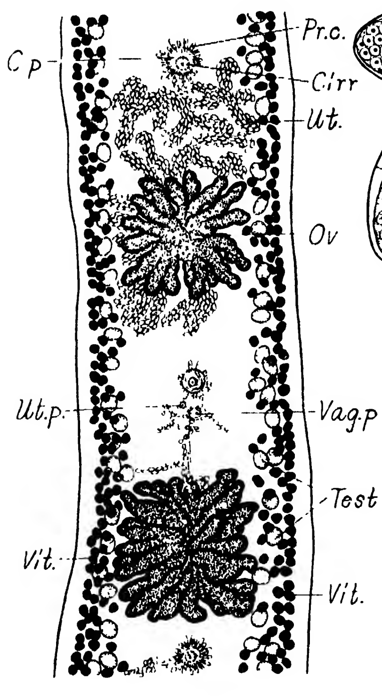

Fig. 3

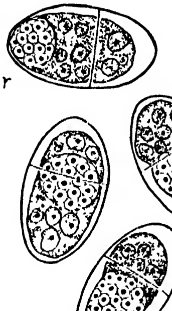

Fig. 2–3. *Spathebothrium simplex* Linton, 1922.

Fig. 2. Two reproductive sets, of which the anterior opens dorsally and the posterior ventrally.

Fig. 3. Eggs. 39–45× 24–28 μ.

the breadth of the body, but not farther forward than the vaginal aperture. The beginning of the germiduct is provided with a sphincter, forming an oocapt. The receptaculum seminis is constricted off from the short ductus seminalis at the proximal end of the vagina. The median uterine coils, surrounded by well developed gland cells, extend forwards to the level of the cirrus opening or a little farther on. The uterus opens in contact with the vagina at the same level or anterolaterally to it. The elongate oval, somewhat thick-shelled eggs measure 0.039–0.045 × 0.024–0.028 mm and contain a segmented ovum; the opercular line is near the middle. The younger eggs are somewhat larger. The wide vaginal opening with a powerful sphincter never lies on the surface opposite the male aperture, so far as I have observed.

With regard to the systematic position of this worm, I agree with Poche and Fuhrmann in including it in Cyathocephalidae Nybelin, but prefer to make it a representative of a new subfamily Spathebothriinae, on the basis of the following characteristics, by which it can easily be distinguished from Cyathocephalinae Lühe.

Spathebothriinae n. subfam.

Subfamily Diagnosis. Unsegmented cyathocephalids without sucking organ. No definite inner longitudinal muscle layer. Uterus opening alongside with vagina, not forming atrium utero-vaginale. Eggs operculate.

Literature cited

Fuhrmann, O. Pseudophyllidea. Kükenthal's Handbuch der Zoologie, Bd. 2 (2), 1931, p. 331.
Linton, E. A new cestode from *Liparis liparis*. Trans. Amer. Micr. Soc., Vol. 41, 1922, p. 118–121.
Poche, F. Das System der Platodaria. Arch. Naturgesch., 91. Jahrg., Abt. A, 2. Heft, 1925 (1926), p. 347–348.

Caryophyllaeidae Claus, 1879

3. *Caryophyllaeus japonensis* n. sp.

Description. A number of this worm were obtained from the intestine of *Cyprinus carpio* from Lake Biwa. They were fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam without being flattened. Serial sections were also prepared. The worm is cylindrical but slightly flattened dorsoventrally, with a somewhat pointed posterior extremity. The anterior extremity with its crenulated anterior margin, truncate or conical according to the state of contraction, and about 1.0 mm broad, is sharply constricted off from the other part of the body measuring 13 × 0.87 mm in the type. The cuticle is about 0.01 mm thick throughout. The subcuticular musculature consists of a single layer of longitudinal fibers in the head and neck regions, but consists in the remaining part of the body of two layers, of which the outer lies directly under the basement membrane of the cuticle and corresponds to the "Stäbchen-

Fig. 4

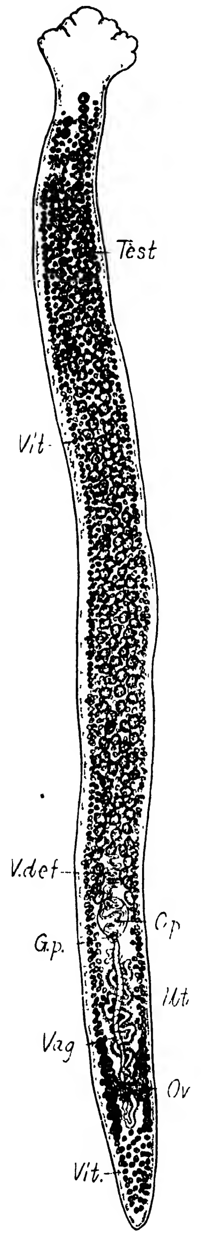

Fig. 4. *Caryophyllaeus japonensis.* Type 13 × 0.87 mm.

schicht" of Will. The subcuticular cells are well developed except in the head and neck, where they are separated from the subcuticular muscle layer by exceedingly fine fibers originating from the inner longitudinal muscles and attached to the basement membrane of the cuticle. On the inner side of the cortical parenchyma there is a highly developed excretory plexus. The epimedullary inner longitudinal muscle layer becomes separated in the anterior end of the body into bundles running forwards in the medulla and splitting up into the fibrillae mentioned above. The "Faserzellenstränge" of Will are clearly recognizable even in total mounts; they are, in my opinion, nothing but the complex of the longitudinal muscle fibers and the particularly condensed parenchymatous tissue of the medulla. The transverse muscle fibers of the medullary parenchyma do not form any definite layer. It is worth noting that the cortical as well as the medullary parenchyma of the head and neck contains abundant exceedingly fine granular substance.

The roundish testicles extend in the peripheral zone of the medulla from a little behind the head to the cirrus pouch. The vas deferens is greatly convoluted in front of the cirrus pouch enclosing a relatively small vesicula seminalis at the base. The protrusible cirrus, lined by a thick cuticle, fills up almost the entire space of the cirrus pouch. The latter, about 0.5 × 0.44 mm and strongly muscular, contains large numbers of coarse muscle fibers running in various directions around the convoluted cirrus, which opens just in front of the uterovaginal aperture into the genital atrium, whose aperture lies at about the middle of the anterior half of the posterior third of the body.

The H-shaped ovary consists of irregularly lobulated arms and a broad ventral connection, and lies just behind the middle of the posterior third of the body. The germiduct receives the vagina behind the middle part of the ovary and then unites with the vitelline duct. The shell gland is well developed. The uterus is divided into three distinct parts, as pointed out by Will for *Caryophyllaeus mutabilis* Rud. The convoluted proximal portion, with a wall composed of thin circular muscle fibers, lies partly dextral and partly dorsal to the shell gland, and is lined by an epithelium, whose nuclei project prominently into the lumen. The longest middle part of the uterus, "der eigentliche Uterus" of Will, turns

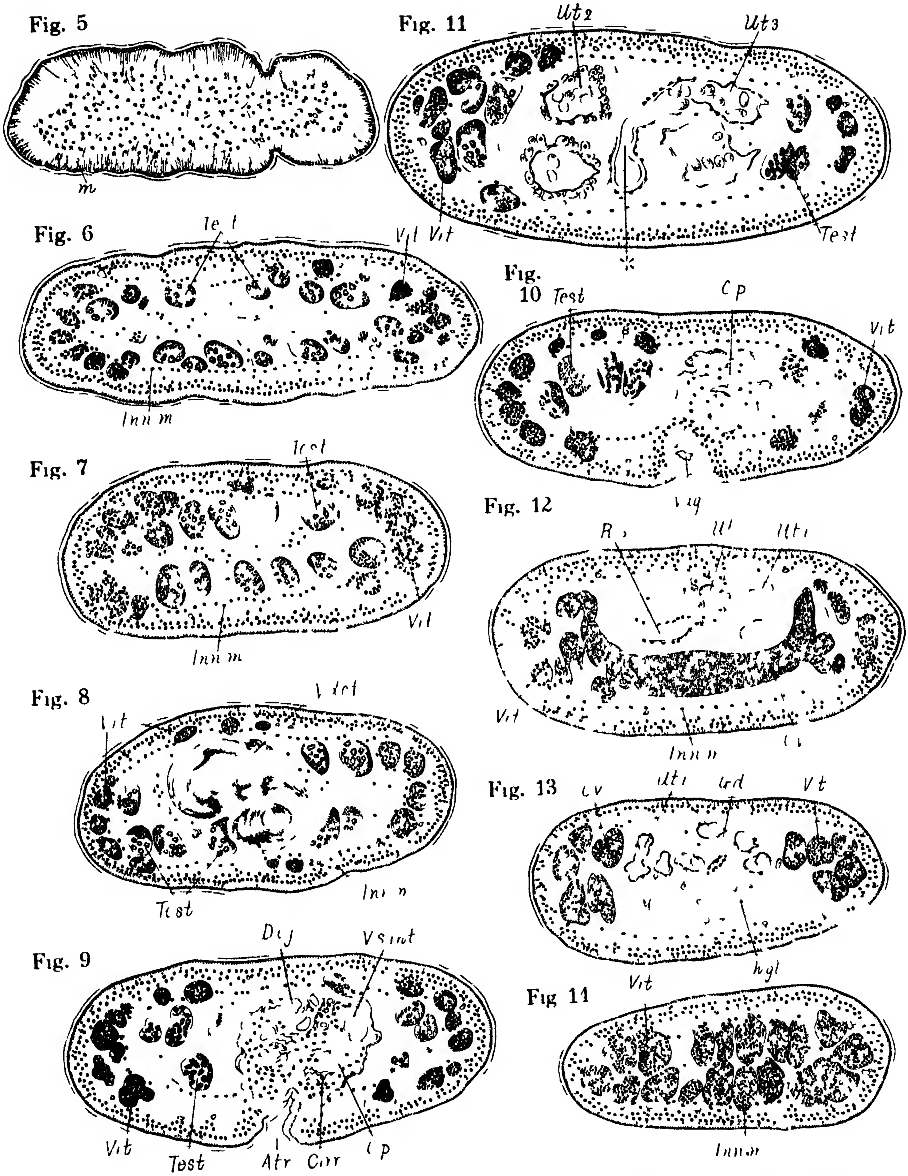

Fig. 5–14. *Caryophollaeus japonensis*. Transverse sections at various levels.
* Junction of uterus with vagina.

forwards at its origin at the level of the posterior end of the ovarian arms and crossing the middle part of the ovary on its dorsal side ascends windingly dorsal to the vagina; the pear- or club-shaped, strongly basophil uterine gland cells form a dense coat around the uterus; their secretory granules are seen on the outer as well as on the inner surface of the uterus.

The distal portion of the uterus is also winding and joins the vagina a little behind the genital atrium to form a short, thick-walled ductus utero-vaginalis. This duct has a hair-like lining as in *Caryophyllaeus mutabilis* of Will and is surrounded by small, deeply staining cells; its wall is mainly composed of strong circular muscle fibers. In living worms flattened under a cover slip the uterovaginal opening appears separate from the male aperture as in *Caryophyllaeus tuba*, but in whole mounts not subjected to pressure the utero-vaginal duct opens with the cirrus into the genital atrium. The vagina passing in the median line at first ventral to the uterus and then dorsal to the middle part of the ovary, consists of three functionally different parts as in *Caryophyllaeus mutabilis* of Will: the long distal vaginal canal largely similar in structure to the ductus utero-vaginalis; the bottle-shaped, relatively thin-walled middle part with inconspicuous hair-like lining, functioning as receptaculum seminis; and the narrow proximal part ("Befruchtungsgang" of Will, "Ductus seminalis" of Nybelin) with circular muscle fibers and small numbers of Begleitzellen. The oval thin-shelled eggs mounted in balsam measure 0.048–0.057 × 0.036–0.042 mm.

The vitelline follicles extending from about the level of the anterior end of the testicles to the anterior end of the excretory vesicle, are interrupted for a short distance on the outer side of the ovarian arms; they are mostly confined to the cortical parenchyma just outside the inner longitudinal muscle layer, but in the postovarian area they lie in the medulla.

The approximately funnel-shaped excretory vesicle, 0.15 × 0.1 mm, opens at the posterior tip of the body and gives off from its anterolateral corners paired main collecting tubules. There are eight to ten longitudinal vessels communicating with one another under the subcuticular cell layer. The crenulated margin of the head is supplied with exceedingly fine, sinuous longitudinal excretory branches connected with one another by transverse commissures.

Discussion. This species most closely resembles *Caryophyllaeus laticeps* (Pallas, 1781), the type of the genus, but differs from it distinctly in the size of eggs as well as in the position of vitellaria. According to Will the vitelline follicles of *C. mutabilis* (syn. of *laticeps*) are confined to the medulla inside the inner longitudinal muscle layer, but in my worm they lie in the cortex just outside this layer. This difference may be of generic significance, but I prefer to assign my species for the present to *Caryophyllaeus* Gmel., 1790.

Caryophyllaeus japonensis n. sp.

Specific Diagnosis. *Caryophyllaeus* Gmel., 1790. Body approximately cylindrical, 10–20 mm or longer. Head constricted off, truncate or conical, with irregularly crenulated anterior margin. Vas deferens strongly convoluted in front of cirrus pouch. Vesicula seminalis interna small. Protrusible cirrus opening into genital atrium just in front of uterovaginal aperture. Ovary H-shaped, just behind middle of posterior third of body. Receptaculum seminis vaginae small. Ductus utero-vaginalis short. Genital atrium opening at middle of anterior half of posterior third of body. Eggs 0.048–0.057 × 0.036–0.042 mm. Preovarian vitelline follicles cortical, just outside inner longitudinal muscle layer.

Habitat. Intestine of *Cyprinus carpio*.

Locality and date. Lake Biwa; Dec. 26, 1926.
Type and paratypes in my collection.

4. *Caryophyllaeus gotoi* Motomura, 1927

Motomura found this cestode in the alimentary canal of *Misgurnus anguillicaudatus* (Cantor) from Korea. I also obtained it in the same host species from the Prefectures of Siga, Kyôto and Hyôgo. In the following will be given some anatomical details missing in Motomura's description.

The mature worms at my disposal, fixed in alcohol, stained in carmine and mounted in balsam, range from 3.7 mm to 7.5 mm in length and from 0.4 mm to 0.57 mm in maximum breadth at the level of the cirrus pouch. The head, 0.5–0.8 mm broad, is strongly flattened dorsoventrally and longitudinally furrowed both dorsally and ventrally; its apical face may sometimes be withdrawn to form a funnel-shaped depression. The cuticle is about 0.005 mm thick anteriorly and 0.0075 mm posteriorly. The subcuticular longitudinal musculature is rather feebly developed. The inner longitudinal muscle bundles do not form a definite layer except in the head, where they play an important rôle in association with the transverse fibers. In the head and neck the medullary parenchymatous cells are massed together into longitudinal bands, forming the "Faserzellenstränge" of Will. The superficial excretory plexus lies under the subcuticular cell layer.

The roundish, relatively large testicles lie in the medulla, surrounded on all sides by the vitelline follicles. The convoluted vas deferens leads directly into the ductus ejaculatorius enclosed in the muscular cirrus pouch. The stout protrusible cirrus opens into the shallow genital atrium immediately in front of the uterovaginal aperture.

The H-shaped ovary extends anteriorly to the level of the genital atrium. The germiduct arises from the ventral surface of the broad middle part of the ovary and soon joins the vitelline reservoir immediately under the ovarian bridge, a little to the right of the median line. The shell gland lies ventrally just behind the middle part of the ovary. The uterus is divided into three parts as in the preceding species: the thin-walled proximal part coiling itself several times on the posterodorsal side of the shell gland; the middle glandular part, beginning at about the level of the posterior end of the ovarian arms, then descending for a short distance before turning dorsad to take an ascending course along the dorsal wall of the body, and extending anteriorly to near the level of the anterior end of the cirrus pouch, where it bends back on itself to descend between the ascending limb and the cirrus pouch; and the short thin-walled distal part joining the vagina behind the cirrus pouch to form the ductus utero-vaginalis lined by a thick cuticle, and running almost dorsoventrally to open immediately behind the male aperture. The vagina consists of three distinct parts: the somewhat sinuous distal part with a thick cuticular wall surrounded by small numbers of Begleitzellen and passing ventral to the glandular uterus; the middle part, the receptaculum seminis, lying anterodorsal

to the ovarian bridge; and the narrow proximal part passing dorsal to the ovarian bridge and curving ventrad round its posterior margin to unite with the germiduct. The preovarian vitelline follicles lie around the testicular field but the postovarian occupy the entire central parenchyma. The small funnel-shaped excretory vesicle opens at the posterior tip of the body.

This species is not only characterized by the small number of testicles as pointed out by Motomura, but also by the anterior extent of the uterus, which in some cases reaches to the posterior limit of the testicles.

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Nybelin, O. Anatomisch-systematische Studien über Pseudophyllideen. Götcborgs Kungl. Vetensk. Vitterh.-Samh. Handl., XXVI, I, 1922, p. 124-129.

Will, H. Anatomie von *Caryophyllaeus mutabilis* Rud. Ein Beitrag zur Kenntnis der Cestoden. Zeitschr. wiss. Zool., 56. Jahrg., 1893, p. 1-39.

5. *Glaridacris limnodrili* n. sp.

ADULT. This cestode was found in the small intestine of *Pseudogobio esocinus* and *Misgurnus fossilis* from the suburbs of Kyôto, and also in the body cavity of *Limnodrilus* sp. from Kamo River. In a paratype fixed in alcohol without pressure the head forms a hexagonal pyramid with a deep median and two shallow submedian sucking grooves on the dorsal and ventral sides, with the base of the pyramid thinning out laterally so as to form a shallow cup, and the terminal disc slightly elevated at the center. When contracted the pyramid may be withdrawn into its basal cup. In the type fixed in Schaudinn's solution under cover glass pressure, the head has completely lost its habitual shape and even the deep median suctorial groove has been obliterated. The body ranges from 1.5 to 2.5 mm in length and from 0.3 to 0.8 mm in maximum breadth just in front of the ovary. The excretory pore at the posterior extremity is marked by a terminal notch.

The cuticle is thinner than in *Caryophyllaeus japonensis* or *C. gotoi*, although the subcuticular cells are well developed. The inner longitudinal muscles form a distinct layer around the vitelline follicles.

The relatively large roundish testicles, about 40 in number, are arranged in two longitudinal rows extending from the neck to near the cirrus pouch. The loosely coiled vas deferens empties into the oval muscular vesicula seminalis externa lying just in front of the cirrus pouch. The narrow convoluted ductus ejaculatorius enclosed in the cirrus pouch is surrounded by numerous deeply staining cells. The stout protrusible cirrus opens to the exterior at the level of the posterior end of the cirrus pouch. The latter, about 0.5 mm in diameter, has a thick muscular wall mainly composed of circular fibers.

The bilobed ovary, 0.17×0.28 mm, lies at the beginning of the last sixth

of the body. The germiduct arising from the median ventral surface of the ovary joins the vagina just behind the ovarian isthmus and then the incurved vitelline reservoir. The shell gland is well developed. The thin-walled proximal part of the uterus leads into the glandular middle part near the posterior end of the body. The latter passes dorsal to the ovarian isthmus and describes a few transverse coils in front of it. The distal part of the uterus does not extend farther forward than the cirrus pouch ; it opens with the vagina into the genital atrium just behind the male aperture. The distal portion of the vagina is lined by a very thick cuticle. There is no receptaculum seminis vaginae as in *Glaridacris catostomi* Cooper, 1920. The elongate oval, thin-shelled eggs measure 0.05–0.057 × 0.03–0.036 mm in mounted specimens. The vitelline follicles extending in the lateral area of the medulla from a little behind the anterior limit of the testicles to the posterior end of the body intrude at various intervals into the testicular field. In a specimen whose uterus is distended with eggs, the vitellaria tend to be interrupted on both sides of the uterus.

Fig. 15

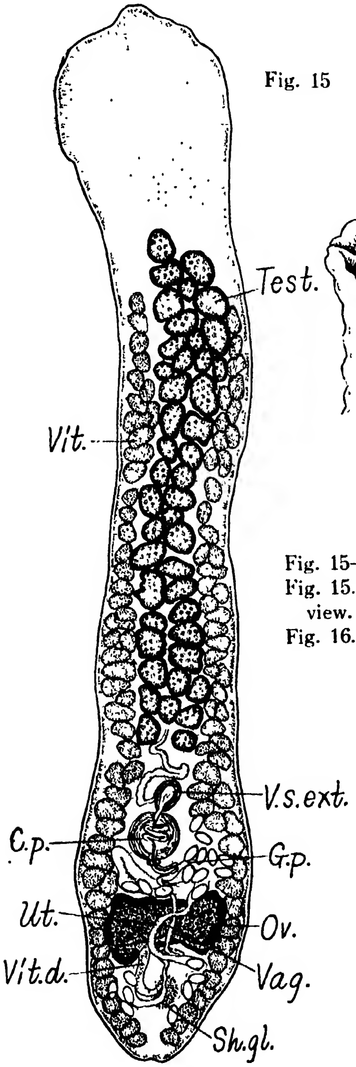

Fig. 16

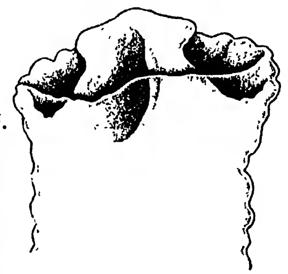

Fig. 15–16. *Glaridacris limnodrili.*
Fig. 15. Entire worm; dorsal view. Type 2.5 mm long.
Fig. 16. Scolex in habitual form.

The excretory system could not be worked out in detail. There is no true excretory vesicle, although the notch at the posterior end of the body leads into a wide tubular cavity functioning as vesicle.

The two fully matured specimens from the body cavity of a tubificid, fixed

in Schaudinn's solution under slight cover glass pressure, measure 1.8×0.37 mm and 2.28×0.42 mm respectively. They conform well to the specimens from fish hosts in anatomical details except in the number of testicles, which is 35 in the smaller specimen and about 50 in the larger.

DISCUSSION. From the above description it is certain that a *Limnodrilus* may serve as a definitive host, and in view of the fact that the host fishes mentioned above are known to be a tubificid eater, there is no doubt that this tubificid is also an intermediate host, so that this cestode can complete its life cycle with or without an intermediate host.

The differences shown in the following table are sufficient to justify the creation of a new species.

	G. catostomi Cooper, 1920	*G. confusus* Hunter, 1929	New species
Body	$5-25 \times 0.4-1.0$ mm	$3.0-7.0 \times 0.2-0.8$ mm	$1.5-2.5 \times 0.3-0.8$ mm
Testicles	150-160 beginning at same level as vitellaria	25-35 beginning at about same level as vitellaria	35-50 beginning farther anteriorly than vitellaria
Vitellaria	interrupted	interrupted	usually continuous
Eggs	$0.054-0.066 \times 0.038-0.048$ mm	$0.037-0.048 \times 0.02-0.031$ mm	$0.05-0.057 \times 0.03-0.036$ mm
Hosts	*Catostomus commersonii*	*Ictiobus bulbalus, Dorosoma cepedianum*	*Pseudogobio esocinus, Misgurnus fossilis, Limnodrilus* sp.

Glaridacris limnodrili n. sp.

SPECIFIC DIAGNOSIS. *Glaridacris* Cooper, 1920; with generic characters. Body $1.5-2.5 \times 0.3-0.8$ mm. Testicles 35-50 in number, beginning a little farther in front than vitellaria and reaching to level of muscular vesicula seminalis externa or near it. Ovary at beginning of last sixth of body. Receptaculum seminis vaginae absent. Vitellaria usually not interrupted on sides of uterus and ovary. Eggs $0.05-0.057 \times 0.03-0.036$ mm.

Habitat. Intestine of *Pseudogobio esocinus* (type host) and *Misgurnus fossilis.* Body cavity of *Limnodrilus* sp.

Locality and date. Kyôto and suburbs; July 16, 1928; December 9, 1931 (type date).

Type and paratypes in my collection.

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Cooper, A. R. *Glaridacris catostomi* gen. nov., sp. nov.; a cestode parasite. Trans. Amer. Micr. Soc., Vol. 39, No. 1, 1920, p. 5-24.

Hunter, G. W. New Caryophyllaeidae from North America. Jour. Parasit., Vol. 15, No. 3, 1929, p. 189-190.

BOTHRIOCEPHALIDAE Blanchard, 1849

6. *Bothriocephalus manubriformis* (Linton, 1889)

This species characteristic of *Histiophorus* seems to be widely distributed, inasmuch as it has been found in the Altantic, Indian and Pacific Oceans. I

obtained it on October 19, 1929, from the small intestine of *Histiophorus orientalis* Temm. et Schl. from Toyama Bay. Since the anatomy of the worm agrees well with Cooper's detailed description, I will make here only a brief note on the eggs.

The two sorts of eggs recognized by Linton are evidently due to age difference, as suggested by Cooper. I have found the eggs fixed in alcohol and examined in water to measure 0.051–0.057 × 0.036–0.041 mm, while according to Linton they are 0.045–0.054 × 0.027–0.03 mm and according to Cooper 0.058 × 0.034 mm in sections. They are elongate oval, thick-shelled and operculate; the contained ovum is segmented but not embryonated.

The most outstanding feature of this species is the extremely muscular cirrus pouch deflected towards the vas deferens in its inner half.

7. *Bothriocephalus japonicus* n. sp.

Description. A small number of this tapeworm were found in the small intestine of *Anguilla japonica* from Kasumiga-ura. They were fixed in alcohol, stained with carmine and mounted in balsam. The largest example in four pieces is about 12 cm long and 2.8 mm broad, gradually increasing in breadth posteriorly. The scolex is plump, 0.62 × 0.36 mm, with a terminal disc and two bothria about 0.44 mm long. The anterior proglottides, 2–3 times as broad as long, are arranged in groups of two with indistinct transverse furrow between. Posteriorly the external segmentation does not exactly correspond to the internal, and the lateral margins become strongly convex and assume a markedly crenate appearance in strong contrast to the first segments. The ripe posterior proglottides are 2.6–2.8 mm broad by 0.18–0.25 mm long. The cuticle is only 3 μ thick. The outer longitudinal muscle fibers underlying the cuticle is poorly developed, while the inner bundles form a very conspicuous layer.

Fig. 17

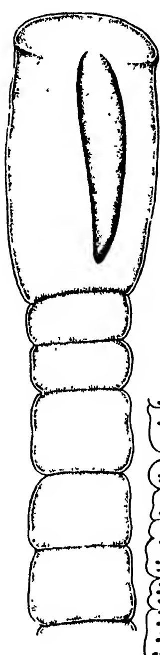

Fig. 18

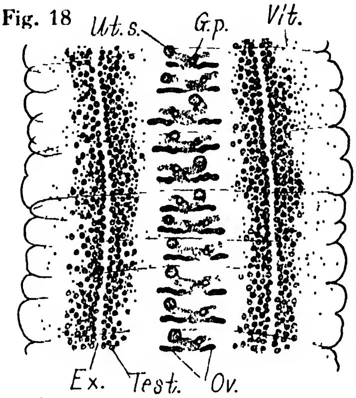

Fig. 19

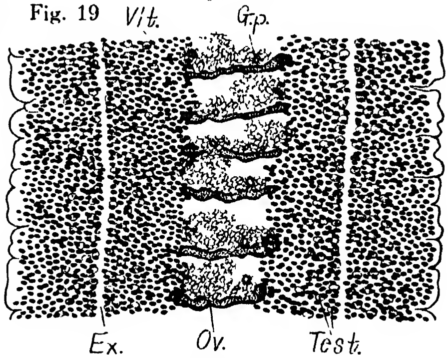

Fig. 17–19. *Bothriocephalus japonicus*.
Fig. 17. Scolex; surficial view. Type 0.62 × 0.36 mm.
Fig. 18. Immature proglottides; dorsal view.
Fig. 19. Gravid proglottides; dorsal view. 2.6–2.8 mm broad.

The small spherical testes, 60–80 in number and continuous from proglottis to proglottis, are confined in the lateral medulla. The compactly coiled vas deferens lies ventrolateral to the proximal end of the cirrus pouch opposite the uterine sac, indifferently on either side of the median line. The muscular cirrus pouch, 0.12 × 0.07 mm, extends through the inner muscle layer into the medulla on one side of the median line. The ductus ejaculatorius, with a definitely larger caliber than the cirrus proper, is convoluted at the base of the cirrus pouch. The cirrus proper forms with the vagina a small funnel-shaped cloaca opening dorsally a little to one side of the median line in front of the ovarian level.

The anteroposteriorly compressed ovary, 0.75 mm in maximum breadth, lies along the posterior border of the proglottis, with its lobulated wings directed dorsolaterally. The uterine duct extends first in the direction of the vas deferens as far laterally as the edge of the ovary and then turning back on itself crosses the median line and enlarges on the opposite side into the transversely elongated, oval uterine sac situated ventrally in front of one of the ovarian wings. The ventral uterine pore lies indifferently on either side of the median line. The oval, thin-shelled eggs measure about 0.045–0.047 × 0.03–0.032 mm. The vagina opening directly behind the cirrus passes ventroposteriorly to join the germiduct dorsal to the ovarian isthmus. The extremely numerous vitelline follicles occupy almost the whole of the cortical parenchyma between the inner longitudinal muscles and the subcuticular cell layer, excepting the narrow median field and the lateral edges.

In each submedian field there are three main ventral excretory vessels connected by side branches. The dorsal vessels, also three in number, are much finer than the ventral, but in the anterior segments they are of equal caliber.

DISCUSSION. This species bears a certain resemblance to *Bothriocephalus manubriformis* (Linton, 1889), but differs markedly in external anatomy. From *B. claviceps* (Goeze, 1782), to which my worm is allied in some external features as well as in host relationship, it can be easily distinguished by the position of the coiled vas deferens and by the extent of the vitellaria. In *B. claviceps* the coils of the vas deferens lie, according to Cooper, close behind the uterine sac and the vitellaria are not separated into two fields on each surface but continuous around the reproductive apertures. The eggs are decidedly smaller in my species than in *claviceps* and *manubriformis*.

Bothriocephalus japonicus n. sp.

SPECIFIC DIAGNOSIS. *Bothriocephalus* Rud., 1868. Body over 120×2.8 mm, with plump scolex. Anterior proglottides 2–3 times as broad as long, arranged in groups of two with indistinct transverse furrow between, other transverse furrows being well marked; posterior proglottides 10–15 times as broad as long, with convex lateral margin. Testes small, spherical, 60–80 for each proglottis. Coiled vas deferens opposite uterine sac. Ovary up to 0.75 mm in breadth, consisting of ventral isthmus and lobulated dorsolateral wings. Uterine duct voluminous, on both sides of median line. Uterine sac transversely elongated oval, on right or left of median line,

not encroaching on neighboring segments. Vitelline follicles occupying almost entire lateral cortical parenchyma, not united in median field. Genital cloaca funnel-shaped, opening dorsally a little to one side of median line. Eggs 0.045–0.047×0.03–0.032 mm. With three main longitudinal excretory vessels in each submedian field both dorsally and ventrally.

Habitat. Small intestine of *Anguilla japonica*.

Locality and date. Kasumiga-ura; April 14, 1929.

Type and paratypes in my collection.

8. *Bothriocephalus acheilognathi* n. sp.

DESCRIPTION. A single worm about 80 mm long was found in the small intestine of *Acheilognathus rhombea* from Lake Ogura. The globose scolex about 0.5 mm in diameter has a prominent terminal disc and two surficial

Fig. 21

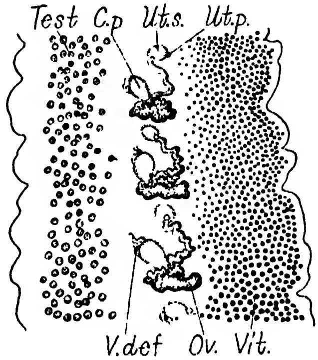

Fig. 20

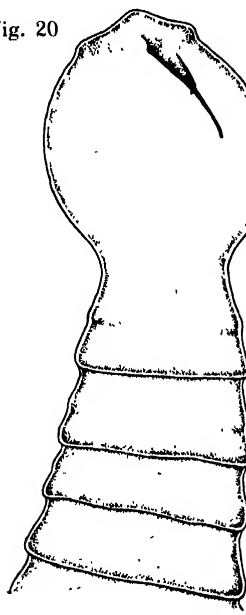

Fig. 22

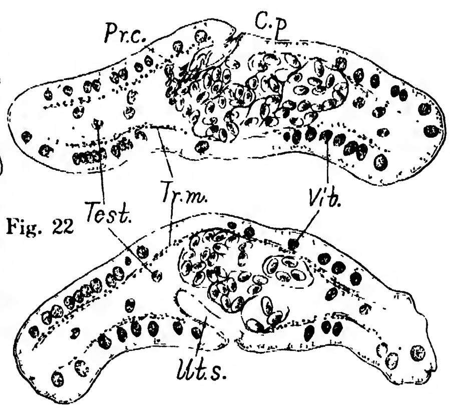

Fig. 20–22. *Bothriocephalus acheilognathi.*

Fig. 20. Scolex; surficial view. Type 0.5 mm across.

Fig. 21. Immature proglottides; ventral view. Testes and vitellaria represented unilaterally.

Fig. 22. Transverse sections of gravid segment.

bothria about 0.31 mm long, the free posterior edges of which approach each other to enclose a tube-like cavity. The segmentation beginning immediately behind the scolex is complete throughout the strobila. The first and the third segments are not sharply set off from the second and the fourth respectively.

In the anterior proglottides about four times as broad as long, the posterior borders project on either side, giving rise to serrations. The posterior proglottides have almost parallel sides and are a little broader than long. The first genital anlage is found in the thirteenth segment and the egg production begins in the thirty-first. The cuticle is about 5 μ thick. The subcuticular cells form a thick layer, with the nuclei close to the cuticle. The inner longitudinal muscle fibers are arranged in bundles of irregular shape and width. The fine transverse fibers are numerous in the medulla, especially in the longitudinal muscle layer.

The spherical testicles, 80–100 in number for each proglottis and slightly larger than the vitelline follicles, are distributed in the lateral medulla. The convoluted vas deferens lies ventrolateral to the proximal end of the cirrus pouch, opposite the uterine duct. The pear-shaped muscular cirrus pouch, 0.16 × 0.08 mm in transverse section, is directed a little obliquely towards the side opposite the uterine duct, and closely applied to the latter when it is distended with eggs. Around the proximal end of the cirrus pouch there is a mass of elongate gland cells, whose ducts penetrate the base of the cirrus pouch to empty into the inflated proximal part of the ductus ejaculatorius, the distal half of which is strongly curved. These gland cells are undoubtedly prostatic in nature, as suggested by Cooper, who observed a similar structure in *Bothriocephalus scorpii*. The straight protrusible cirrus opens dorsally with the vagina into the genital cloaca only slightly to one side of the median line, just in front of the ovarian level.

The bilobed, anteroposteriorly compressed ovary is situated in the median line close to the posterior border of the proglottis; it consists of two dorsolateral wings and a ventromedian isthmus, from which arises the oocapt on the dorsal side. The germiduct forms a small cistern at the junction with the vagina anterodorsal to the ovary and then joins the vitelline reservoir. The proximal end of the uterine duct is surrounded by large numbers of shell gland cells near the dorsal layer of the inner longitudinal muscles. The voluminous main bulk of the uterus consists of extremely close coils extending in the median medulla from the ovary to the spacious muscular uterine sac. This sac opens in the median line or a little to one side near the anterior border of the proglottis. The elliptical, thin-shelled eggs are about 0.051–0.054 × 0.033–0.037 mm. The extremely numerous vitelline follicles, arranged in a layer, fill up almost the entire cortical parenchyma except the narrow median field, some lying occasionally in the median line. In the posteriorly rounded last segment the vitelline follicles occupy the postovarian median field about 0.3 mm long.

Of the excretory system there are two very fine main longitudinal vessels in the submedian medulla.

DISCUSSION. Although this species has a somewhat atypical scolex, the internal anatomy justifies its being included in *Bothriocephalus*. The specific diagnosis is reserved until additional specimens come to hand.

9. *Bothriocephalus opsalichthydis* n. sp.

Description. This tapeworm is very common in the small intestine of *Opsalichthys uncirostris* from Lake Biwa and River Yodo. It is very fleshy and may be more than 10 cm long. The maximum breadth of the posterior end is over 1.25 mm. The approximately heart shaped scolex has a prominent terminal disc and deep surficial grooves. In mounting the scolex tends to lie on its side because of its being compressed laterally. The thick free edges of the bothria are united posteriorly to enclose the suctorial grooves extending to near the base of the scolex; they are reinforced by powerful longitudinal muscles, which split up posteriorly into individual bundles to form the powerful

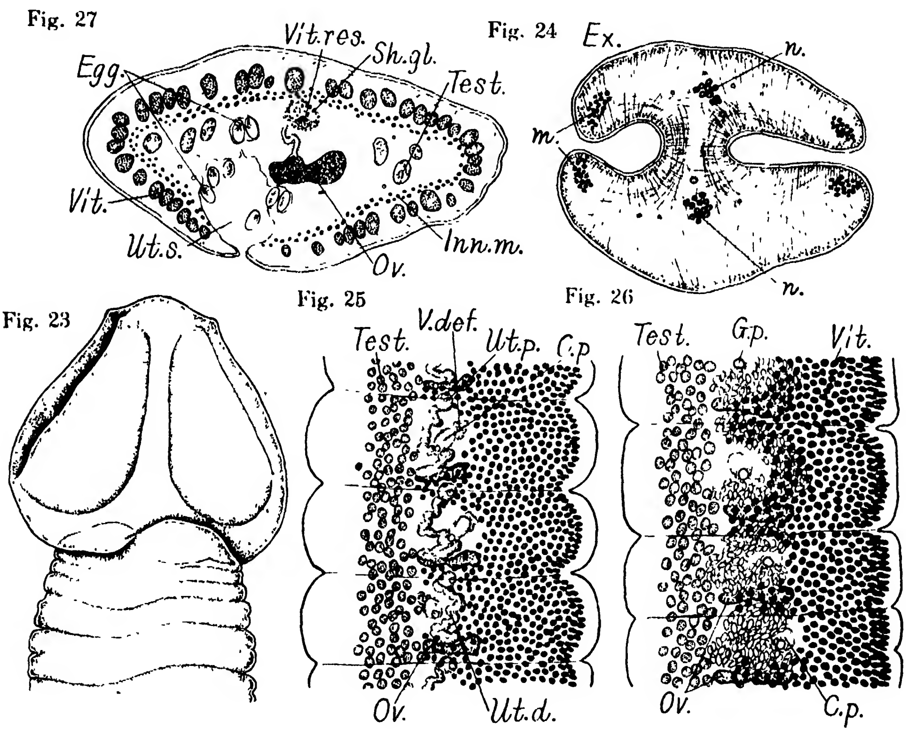

Fig. 23–27. *Bothriocephalus opsalichthydis*.
Fig. 23. Scolex; lateral view. Fig. 24. Transverse section of scolex. Fig. 25–26. Maturing and gravid segments; dorsal view. Testes and vitellaria shown unilaterally. Fig. 27. Transverse section of gravid segment.

inner layer running throughout the strobila. The segmentation is complete throughout, although there is an indistinct secondary segmentation in the anterior part of the strobila where each proglottis, much broader than long and with strongly convex lateral edges, is sharply marked out. The mature posterior proglottides, 3–4 times as broad as long, are longer than the anterior, with more or less flat, almost parallel lateral margins, which may be wrinkled transversely. The cuticle is about 6 μ thick. The subcuticular longitudinal muscles

are particularly well developed around the suctorial grooves. In the scolex there are numerous fine parenchymatous muscle fibers radiating from the wall of the grooves or passing longitudinally along it.

The paired cephalic ganglion is found in the scolex under the terminal disc. The relatively large mass of longitudinal nerve fibers runs through the middle of each lateral half of the scolex and continues into the lateral nerve strand of the proglottides, diminishing in size backwardly.

The main longitudinal excretory vessel lies close and medial to the nerve strand on either side of the scolex. In the proglottides there are two main vessels running between the nerve strand and the median line, the outer one being the larger. Side branches are also given off, some to the farther side of the nerve strands.

The small follicular testes, 60–100 in number and continuous from proglottis to proglottis, are arranged in two lateral fields in the medullary parenchyma. The compactly coiled vas deferens lies ventrolateral to the proximal end of the cirrus pouch, around which gland cells similar to those observed in *B. acheilognathi* mihi are present. The ductus ejaculatorius has a diameter of 0.025–0.032 mm at the base of the cirrus pouch, but its convoluted distal part is only 0.009–0.012 mm wide. The cirrus opens alongside or directly in front of the vagina a little to one side of the median line, about midway between the anterior and the posterior border. The elongate oval muscular cirrus pouch, 0.16 × 0.09 mm, extends well into the medulla and is deflected towards the side opposite the uterine duct even in immature proglottides.

Fig. 28

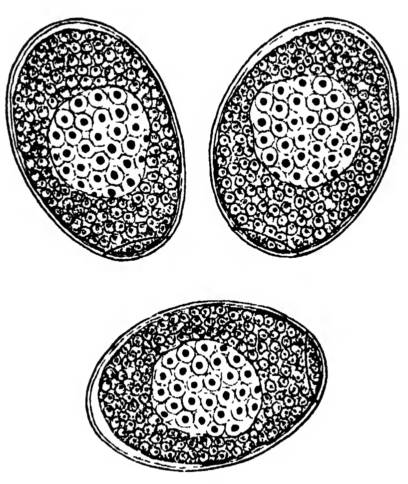

Fig. 28. Eggs of *Bothriocephalus opsalichthydis*. 50–54 × 36–40 μ.

The ovary, 0.43 mm broad in a mature proglottis and lying close to its posterior border, consists of a ventromedian isthmus and two tubulo-lobular dorsolateral wings. The germiduct arising from the oocapt at the median anterodorsal part of the ovarian isthmus joins the strongly recurved vagina and then the vitelline reservoir near the dorsal boundary of the medulla. The cistern or the vestibule of Cooper is not conspicuous in this species. The shell gland cells surrounding the proximal end of the uterine duct are well developed. The closely convoluted, wide uterine duct describes an S-shaped turn opposite the cirrus pouch. The transversely oval, median uterine sac encroaches upon the ovary of the preceding segment, with its median opening just at the anterior border of the proglottis. The slightly elongate oval, relatively thick-shelled, operculate eggs, fixed in alcohol and measured in water, are 0.05–0.054 × 0.036–0.04 mm; the contained ova are

segmented but not yet fully embryonated. The vitelline follicles lie in the cortical parenchyma in two lateral groups which are connected with each other dorsally and ventrally in the median line by isolated follicles.

DISCUSSION. This species is characterized by the scolex and the fresh-water host.

Bothriocephalus opsalichthydis n. sp.

SPECIFIC DIAGNOSIS. *Bothriocephalus* Rud., 1808; with generic characters. Body fleshy, over 100×1.25 mm. Scolex heart-shaped, with prominent terminal disc, strongly compressed laterally; bothria well developed, with fleshy edges. Proglottides sharply marked out, with indistinct secondary segmentation, broader than long throughout. Inner longitudinal muscles forming powerful bundles. Testes 60–100 in number. Coiled vas deferens and muscular cirrus pouch opposite uterine duct. Cirrus opening alongside or directly in front of vagina, a little to right or left of median line. Ovary bilobed, near posterior border of proglottis. Uterine duct capacious, strongly convoluted, S-shaped in outline, on right or left of median line. Uterine sac encroaching upon ovary of neighboring segment, opening in median line at anterior border of proglottis. Eggs slightly elongate oval, 0.05–0.054×0.036–0.04 mm; ova segmented, but not fully embryonated. Vitelline follicles filling up almost entire cortical parenchyma.

Habitat. Small intestine of *Opsalichthys uncirostris*.

Locality. Lake Biwa (type locality), River Yodo.

Date. July 17, 1927 (type date); October 16, 1929.

Type and paratypes in my collection.

10. *Bothriocephalus sciaenae* n. sp.

DESCRIPTION. A few specimens of this worm were found in the small intestine of *Sciaena schlegeli* (Bleeker) from Toyama Bay. They are several centimeters in length and 3 mm in maximum breadth. The scolex of the type, 0.8 mm long and distinctly constricted off from the first segment, has wide surficial bothria and a prominent terminal disc deeply notched laterally as well as surficially, so that it appears quadri-radiate when viewed end on. In the anterior part, segments with salient posterior borders alternate with those with less prominent posterior borders, the latter increasing in number posteriorly from one to three or more, as the strobila widens, and sooner or later becoming as distinct as the former. In the posterior part where the gravid segments are crowded together, the lateral borders are roughly crenulated without regard to the segmentation, which is sometimes recognizable only by the reproductive organs. The posterior borders of the anterior segments may be slightly emarginate or notched in the median line.

The cuticle and the subcuticular musculature are poorly developed. The inner longitudinal muscle sheath is composed of extremely strong, isolated bundles, which become weaker laterally. Inside this sheath there is a thin transverse muscle layer.

The two chief nerve cords are situated in the medullary parenchyma just lateral to the submedian line. In the medulla there are four main excretory vessels arranged in two pairs connected by transverse branches at various levels.

The testes cannot be counted because hidden by the vitellaria, but lie in

a single layer in the lateral medulla. The vas deferens is coiled between the cirrus pouch and the ovary. The elliptical cirrus pouch, 0.13–0.16 × 0.06–0.075 mm, has a well developed muscular wall of some thickness, and is directed at right angles to the dorsal surface in young proglottides but deflected laterally in those with distended uterus. The cirrus opens dorsally in the median line directly in front of the vagina.

The transversely elongate ovary, up to 0.6 mm broad, consists of a median isthmus and two compact lateral lobes which extend dorsally more than ventrally, but do not reach to the dorsal boundary of the medulla. In gravid

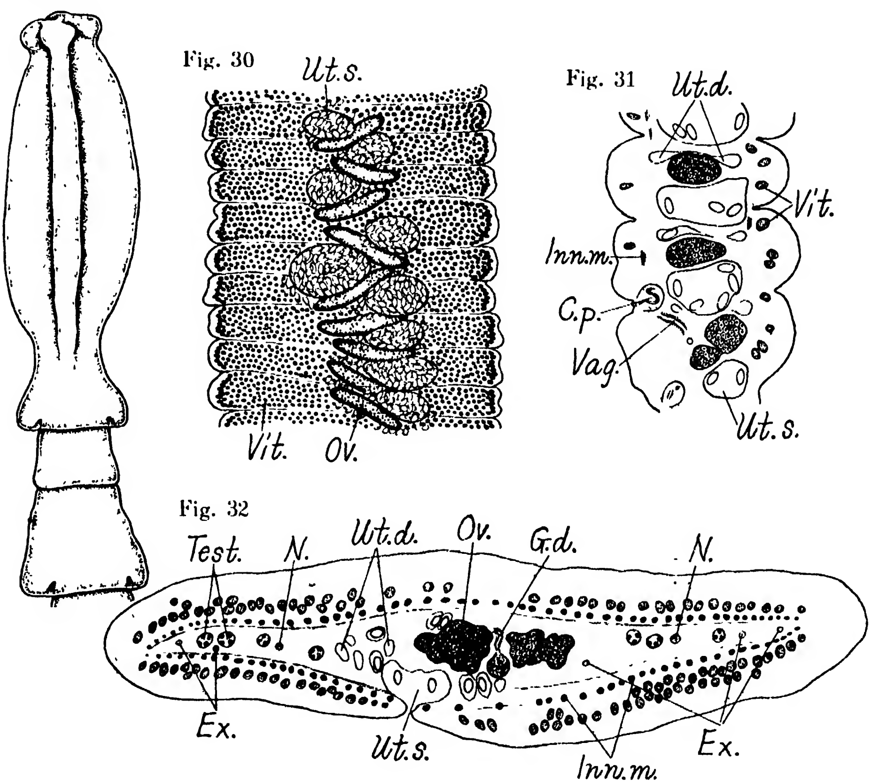

Fig. 29–32. *Bothriocephalus sciaenae.*
Fig. 29. Scolex; ventrolateral view. Type 0.8 mm long. Fig. 30. Gravid segments; ventral view. Ca. 3 mm broad. Fig. 31. Sagittal section of gravid segment. Fig. 32. Transverse section of gravid segment.

segments it takes an irregularly oblique position due to the pressure of the uterus. The germiduct arising from the oocapt on the dorsal side of the ovarial isthmus forms a small cistern at the junction with the vagina and then receives the duct from the oval vitelline reservoir lying dorsal to the isthmus. The uterine duct is coiled between the ovary and the voluminous uterine sac. The latter, oval in outline, variable in size according to its contents and partly

lying in the preceding segment, opens ventrally on the right or left of the median line a little in front of the genital pore. The uterine pores are often overlapped from behind by transverse folds which are more or less deeply notched at the middle, but are exposed in fully gravid segments by complete disappearance of the folds. The elliptical, light brown, operculate eggs, fixed in alcohol and measured in water, average 0.069–0.075 × 0.036–0.042 mm. The narrow vagina opening directly behind the cirrus has no sphincter; it passes posteroventrally to join the germiduct on the dorsal side of the ovarial isthmus. The extremely numerous vitelline follicles lie close together in the cortical parenchyma, and are continuous across the median line and from proglottis to proglottis.

DISCUSSION. This species is characterized by the exceedingly small size of the cirrus pouch, the irregularly oblique position of the ovary, the continuity of the vitellaria from segment to segment, etc., unlike *Bothriocephalus manubriformis* (Linton, 1889), to which it is related more closely than to any other species of the genus.

Bothriocephalus sciaenae n. sp.

SPECIFIC DIAGNOSIS. *Bothriocephalus* Rud., 1808. Body several centimeters long, 2–3 mm broad. Scolex elongate, about 0.8 mm long, with four-lobed terminal disc and wide bothria, with constriction between it and the first segment. Lateral borders of strobila serrate anteriorly, but crenulate posteriorly. Inner longitudinal muscles well developed. Testes not very numerous. Cirrus pouch 0.13–0.16 × 0.06–0.075 mm. Cirrus median, opening directly in front of vagina. Ovary transversely elongate, up to 0.6 mm broad, irregularly oblique in position due to pressure of distended uterus. Uterine sac oval, variable in size, encroaching upon segment ahead, opening a little to one side of median line, overlapped from behind by medially notched transverse folds, but exposed in fully gravid segments. Eggs elliptical, light brown, 0.069–0.075 × 0.036–0.042 mm. Vitellaria continuous across median line and from proglottis to proglottis.

Habitat. Small intestine of *Sciaena schlegeli* (Bleeker).

Locality and date. Toyama Bay; June 18, 1928.

Type and paratypes in my collection.

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Linton, E. Notes on entozoa of marine fishes of New England, with descriptions of several new species. Rep. U. S. Fish Comm. for 1887, 1891, p. 728–731.

11. *Taphrobothrium japonense* Lühe, 1899

The following description is to supplement the original brief account of Lühe. The worm occurs very frequently in the small intestine of *Muraenesox cinereus* from the Inland Sea. The largest specimen at my disposal is about 83 cm in length and 5.0 mm in maximum breadth at about the middle. The elongate scolex, up to 1.8 × 0.53 mm, has a prominent terminal disc and two surficial bothria as long as itself. The external segmentation is incomplete at intervals. The salient posterior borders are distinctly notched at the longitudinal

surficial furrows. The conspicuous outermost furrow lies at about the middle of the lateral half or a little more outward, while the innermost runs at the outer end of the ovarian wing. There are, in addition, more or less conspicuous furrows between the innermost and the outermost or outside the latter. The proglottides are broader than long throughout the strobila, measuring 0.15 ×

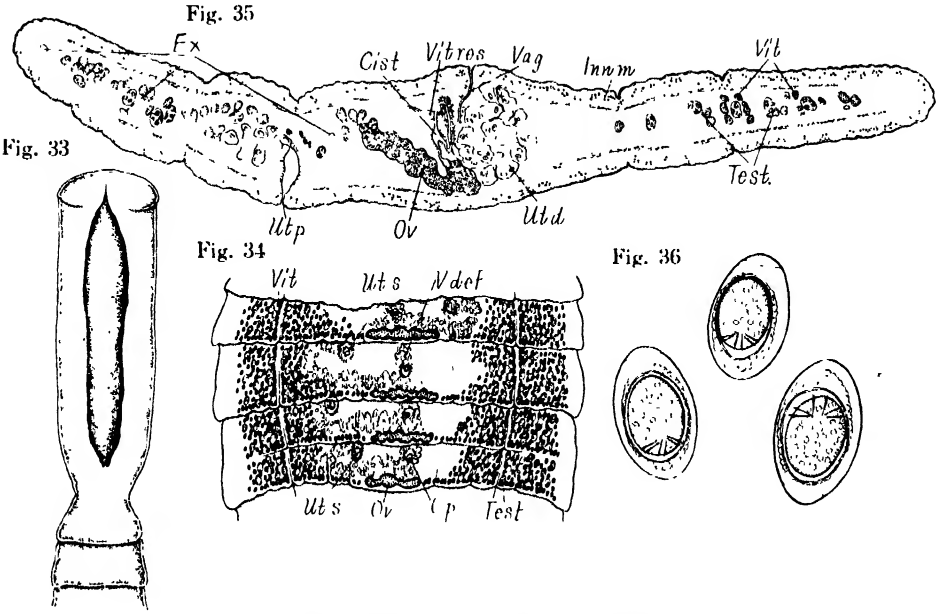

Fig. 33–36. *Taphrobothrium japonense* Lühe, 1899.
Fig. 33. Scolex; surficial view. 1.8 mm long.
Fig. 34. Gravid segments; dorsal view. 2.5 mm broad.
Fig. 35. Transverse section of gravid segment.
Fig. 36. Eggs. 42–45 × 27–30 μ.

0.36 mm in the anterior segments and 0.2–0.56 × 2.5–3.75 mm in the posterior.

The cortical parenchyma is about 0.05 mm thick and loosely meshed but the subcuticular cells form a very compact layer. The poorly developed longitudinal fibers are interwoven with the transverse fibers, and form an inconspicuous sheath for the medulla.

The roundish or elliptical testes are in two lateral groups in the middle of the medulla, with their long axes directed longitudinally or transversely according to the state of contraction of the proglottis; they could not be accurately counted but are probably 40–60 on each side. The compactly coiled vas deferens is closely applied in the median line to the proximal end of the cirrus pouch, and has a short narrow portion before entering the cirrus pouch. The proximal end of the ductus ejaculatorius forms a small thin-walled expansion at the base of the cirrus pouch, which is slightly deflected in an opposite direction to that of the uterine opening. The narrow distal portion of the ejaculatory duct is provided with strong circular muscle fibers. The slender cirrus proper opens dorsally in the median line about midway between the

anterior and the posterior border. The muscular elliptical cirrus pouch is 0.1×0.04 mm in sections.

The median, approximately bilobed ovary, about 0.63 mm broad in fully matured proglottides, is much compressed anteroposteriorly, with its isthmus next the ventral wall of the body but the wings reaching almost to the dorsal boundary of the medulla. The roundish oocapt on the dorsal face of the isthmus is about 0.018 mm in diameter. The very narrow germiduct arising from the oocapt forms a conspicuous cistern at the point of its union with the vagina, and then continues into a slender tubule, which after joining the vitelline reservoir at about the level of the oocapt dorsal to the ovary, turns ventrad to lead into the uterine duct surrounded by a small number of shell gland cells. This duct soon expands opposite the uterine pore between the cirrus pouch and the ovary and then crossing the median line forms the transversely elongated S-shaped uterine convolution extending along the posterior margin of the proglottis to near the outermost longitudinal furrow mentioned above. The spherical muscular uterine sac*, variable in size in accordance with the degree of distention, opens on the right or left submedian line, just in front of the equator of the proglottis. The elongate oval, somewhat thin-shelled, very distinctly operculate eggs, fixed in alcohol and measured in water, are $0.042–0.045 \times 0.027–0.03$ mm, and contain each an oval onchosphere averaging 0.025×0.02 mm and having three pairs of hooks about 0.008 mm long. The narrow vagina opening immediately behind the cirrus passes ventroposteriorly to near the ovarian isthmus, where it turns abruptly dorsad to empty into the cistern described above. The numerous vitelline follicles lie very close together in the medullary parenchyma, the lateral strands and the large median part except the posterior marginal zone being free of them; they are largely intermingled with the testicles, so that their exact number could not be counted. Generally speaking, the follicles tend to lie in the peripheral zone of the medulla and never in the cortex.

The main excretory vessels run along the lateral edges of the strobila outside the vitellaria.

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12. *Ptychobothrium belones* (Duj., 1845) Lönnb., 1889

Syn. *Dibothrium restiforme* Linton, 1891

This species was found in the small intestine of *Tylosurus schismatorhynchus* from the Pacific coast of Mie Prefecture. The scolex, pointed bluntly in front and shouldered behind, is strongly compressed laterally, so that it tends to lie on the side in total mounts; there is no terminal disc as in *Bothriocephalus*.

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*Lühe's diagnosis of the genus should be emended to read: "Uterus ein sehr langer und sehr stark gewundener Kanal, mit Uterushöhle."

Each lateral surface of the scolex has a furrow continuous with that of the proglottides and is conspicuously folded longitudinally. The bothria, dorsal and ventral in position, are so well developed that they give the scolex an approximately H-shaped appearance in transverse sections, with the free attenuated edges rolled in to the very deep fossae. Complete and incomplete segmentations alternate regularly throughout the strobila, at the middle of

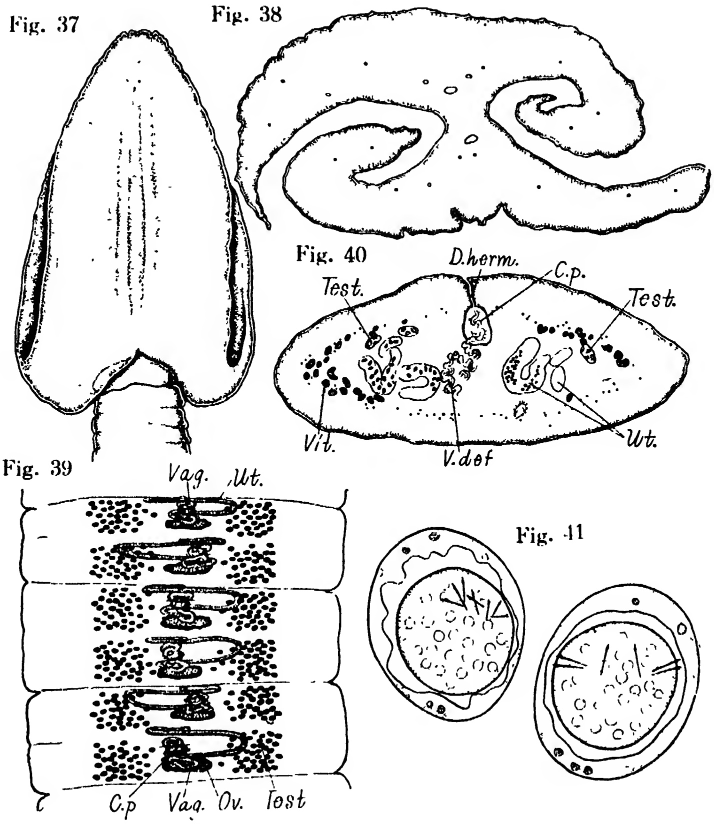

Fig. 37–41. *Ptychobothrium belones* (Duj., 1845).
Fig. 37. Scolex; lateral view. 4.0 mm long. Fig. 38. Transverse section of scolex. Fig. 39. Maturing proglottides. 1.6 mm broad. Fig. 40. Transverse section of gravid segment. Fig. 41. Eggs. 60–66 × 45–54 μ.

which the proglottides have parallel lateral margins and are about seven times as broad as long.

In mature proglottides there are two main longitudinal excretory vessels running through the medullary parenchyma on either side of the median line and giving off side branches at intervals. In the anterior part of the scolex they split up into a highly complex plexus. In the greater anterior part of the scolex the parenchymatous muscle fibers are poorly developed, but posteriorly they become more and more numerous and tend to concentrate around the

paired excretory stems, thus giving rise to the strong inner longitudinal layer of the strobila, which separates into individual bundles, unlike that of *Bothriocephalus*.

The testes, whose exact number could not be determined, lie dorsally in the medulla in two lateral groups. The vas deferens is convoluted ventrolateral to the cirrus pouch. There are no gland cells like those observed in *Bothriocephalus acheilognathi* and *B. opsalichthydis* around the proximal end of the cirrus pouch. The latter consists of a relatively thin layer of muscle fibers, and encloses a proximally enlarged ductus ejaculatorius and an irregularly convoluted cirrus proper opening with the vagina into the narrow hermaphroditic canal, which in turn opens dorsally at the base of the funnel-shaped median genital cloaca in front of the ovarian level. The relatively small compact ovary lies in the median line near the posterior border of the proglottis. The receptaculum seminis is small. The uterine duct takes an anteroposteriorly compressed S-shaped course in immature proglottides, with its anterior turn extending about 0.37 mm outwards from the common genital pore; when filled with eggs, it becomes very sinuous and occupies almost the entire medullary parenchyma; at the distal end it leads into the sharply differentiated uterine sac opening ventrally at the anterior border of the proglottis to one side of the median line. The thin-shelled, non-operculate uterine eggs are exceedingly variable in size according to the state of development; the slightly elongate oval, fully developed ones measure 0.06–0.066 × 0.045–0.054 mm; the contained subglobular embryos, 0.039–0.015 × 0.036–0.042 mm, bear three pairs of hooks about 0.015 mm long. Some onchospheres have seven or eight or rarely ten, rather irregularly arranged hooks. The small vitelline follicles lie in the lateral fields, mostly intermingled with the bundles of the inner longitudinal muscle layer, but leaving the lateral margins and the median field free. The strongly recurved vagina comes to lie in front of the cirrus pouch before joining the cirrus.

DISCUSSION. In 1891 Linton reported a new cestode from the intestine of *Tylosurus caribbaeus* under the name of *Dibothrium restiforme*, but from his meager description it is almost certain that he dealt with *Ptychobothrium belones* (Duj.), of which Janicki has recently given a detailed account. Janicki however places the ovary near the anterior border of the proglottis and so illustrates it in his figures 3, 4 and 9. This is undoubtedly his error caused by mistaking the posterior end of the proglottis for the anterior. Again, he says that the vitellaria occupy the basal part of the cortical parenchyma, where they are intermingled with longitudinal muscular bundles, but to be more accurate, they are not cortical, but intermuscular. In other essential particulars, however, I agree with him, especially in his modification of Braun's diagnosis of *Ptychobothrium*.

On the basis of the above description I venture to emend and to supplement the generic diagnosis of Braun.

Ptychobothrium Lönnberg, 1889

GENERIC DIAGNOSIS. Bothriocephalidae Blanchard, 1849; with family characters given by Lühe for Ptychobothriidae. Scolex spatulate or elongate cordate, compressed laterally, without terminal disc; bothria well developed, dorsal and ventral in position. No neck. Segmentation incomplete. Mature proglottides with two main longitudinal excretory vessels on either side of median line. Testes lateral, near dorsal boundary of medulla. Cirrus pouch relatively thin-walled, without prostatic cells around its proximal end. Cirrus opening dorsally with vagina by hermaphroditic duct at base of funnel-shaped median genital cloaca. Ovary compact, near posterior border of proglottis. Receptaculum seminis small. Uterine duct S-shaped in outline in immature proglottides, but very sinuous and filling up almost entire medulla in mature ones. Uterine sac distinct, opening ventrally at anterior border of proglottis to one side of median line. Vitelline follicles intermingled with inner longitudinal muscular bundles. Eggs thin-shelled, non-operculate, embryonated.

Genotype. *P. belones* (Duj., 1845) Lönnb., 1889.

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13. *Oncodiscus sauridae* n. g. n. sp.

DESCRIPTION. I obtained this species from the small intestine of *Saurida argyrophanes* at Tarumi near Kobe, and at Tomioka, Kyûsyû. The type is about 9.0 mm in length and 1.6 mm in maximum breadth. The scolex, 2.75 × 2.3 mm and strongly compressed laterally, bears a very conspicuous terminal disc consisting of two lateral lobes, the free border of which is closely beset with numerous small hooks about 0.02 mm long and having a plump, stout guard, a short root and a long recurved sharp point. The well developed dorsal and ventral bothria are conspicuously crenulated. The lateral surface of the scolex bears a median longitudinal furrow. The segmentation is complete from the very beginning. The first segments, whose posterior border overlaps the next segment, are 0.52 × 0.06 mm; at the middle of the strobila the segments are 1.3-1.5 × 0.22-0.3 mm and the posterior border with a broad median indentation reaching to the segmentation line projects very prominently; in the posterior part, the segments, 0.5-0.8 × 0.6-0.93 mm, are deeply constricted off from one another, with the posterior border spreading outwards; the last segment is entirely unstainable.

The cuticle is very thin and delicate. The subcuticular longitudinal musculature is well developed. The fine longitudinal muscle fibers originating from the bothria are massed into strong bundles to form a very distinct inner longitudinal layer of the proglottides.

Fig. 42

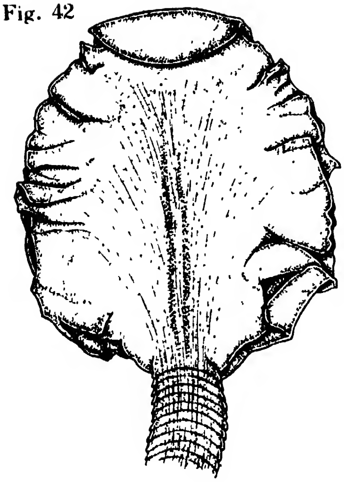

Fig. 43

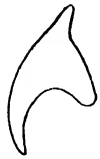

Fig. 46

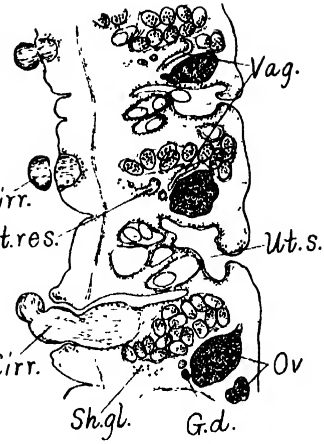

Fig. 44

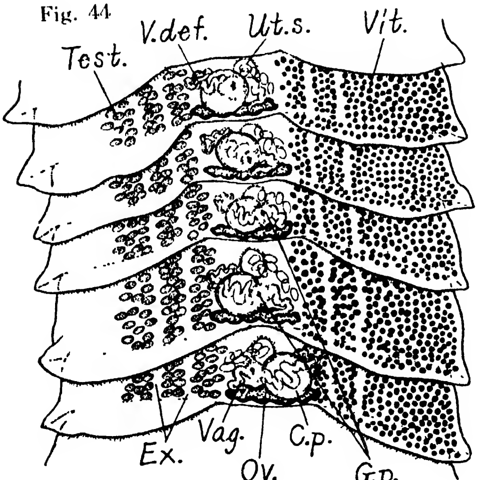

Fig. 45

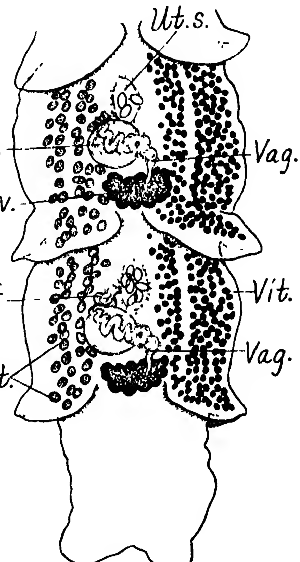

Fig. 47

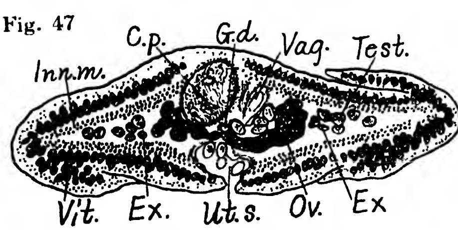

Fig. 48

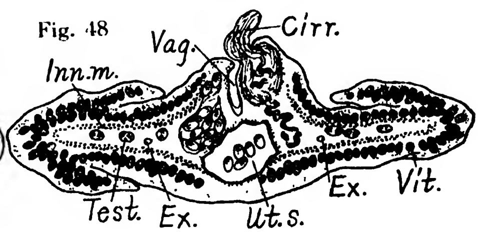

Fig. 42–48. *Oncodiscus sauridae.*
Fig. 42. Scolex; lateral view. Type 2.75 mm long. Fig. 43. Marginal hook of terminal disc. 0.02 mm long. Fig. 44. Anterior gravid segments; dorsal view. 1.6 mm broad. Testes and vitellaria shown unilaterally. Fig. 45. End proglottides; dorsal view. 0.5–0.8 mm long. Testes and vitellaria shown unilaterally. Fig. 46. Sagittal section of gravid segments. Fig. 47–48. Transverse sections of gravid segment.

Of the excretory system there are two main longitudinal vessels in each submedian medulla, the outer one being the narrower and disappearing in the last segments.

The testes, 60–100 in number, are confined to the lateral medullary parenchyma. The compactly coiled vas deferens lies anteroventral and a little lateral to the cirrus pouch. There is no prostatic gland. The large oval cirrus pouch is deflected irregularly to the right or left of the median line directly in front of the ovary; it is relatively thin-walled, and contains a convoluted ductus ejaculatorius and a protrusible cirrus, the interspace being filled with strong muscle fibers and myoblastic nuclei; in total mounts it assumes the appearance of a compact muscular bulb. The cirrus opens dorsally with the vagina just behind the equator of the proglottis, slightly opposite to the cirrus pouch and not exactly in the median line.

The transversely elongate lobulate ovary lies just in front of the posterior segmentation line. It consists of a ventral isthmus and two dorsally extending lateral wings. The germiduct joins the vitelline reservoir after receiving the vaginal duct dorsal to the median part of the ovary. There is no receptaculum seminis. The shell gland around the proximal end of the uterine duct is well developed. The uterine duct coils forwards between the ovary and the cirrus pouch and then in front of the latter to lead into the muscular uterine sac opening ventrally in the median line at about the middle of the proglottis by a longitudinally elongated or slit-like pore. In a specimen about 20 cm long, the uterine sacs of two isolated segments are enormously distended by the contained eggs into a large globular mass bulging out both dorsally and ventrally and encroaching upon the ovary of the preceding proglottis. The elliptical, thin-shelled, operculate eggs measure 0.06–0.063 × 0.039–0.042 mm, containing each an unsegmented ovum surrounded by yolk cells and a large vacuole produced by the liquefaction of the yolk.

The closely massed vitelline follicles occupying the entire basal cortical parenchyma except the median field extend into the free posterior edges of the proglottis. The vitelline reservoir lies dorsal to the ovarian isthmus.

The vagina opening directly in front of the cirrus is divided into two parts, the very wide distal part with a relatively thick muscular coat, passing ventrolaterally, and the less muscular and definitely narrower proximal part turning posterodorsad to join the germiduct.

Discussion. This tapeworm is characterized by the presence of closely set minute hooks on the margin of the terminal disc, by the bell-shaped proglottides with a median indentation on the posterior border, by the conspicuous cirrus pouch studded with strong muscle fibers, by the distally enlarged muscular vagina, by the uterine sac opening by a longitudinal slit-like aperture and sometimes transformed into an excessively large, prominent globular bulging, etc. From general anatomy the worm is obviously a bothriocephalid, but cannot be assigned to any known genus of the family.

Oncodiscus n. g.

GENERIC DIAGNOSIS. Bothriocephalidae Blanchard, 1849. Scolex strongly compressed laterally, with terminal disc armed with minute hooks on its free margin; bothria dorsal and ventral, much crenulated. Segmentation complete. No neck. Proglottides broader than long, bell-shaped, with median indentation on posterior border. Inner longitudinal muscle layer well developed. Two main longitudinal excretory vessels in each submedian medulla. Testes in lateral medulla. Cirrus pouch not very thick-walled, studded with strong muscle fibers. No prostatic cells. Cirrus protrusible, opening directly behind vagina by prominent genital cloaca in middorsal line behind middle of proglottis. Vagina greatly enlarged and muscular in its distal part. Ovary compact, lobulate, near posterior segmentation line. No distinct receptaculum seminis. Uterine duct coiling forwards in median field. Uterine sac opening ventrally in median line by longitudinally elongated pore at about middle of proglottis, sometimes enormously expanded and encroaching upon ovary of preceding segment. Vitelline follicles very numerous, entirely cortical. Eggs thin-shelled, operculate, with unsegmented ova. Parasitic in marine fishes.

Genotype. *Oncodiscus sauridae.*

Oncodiscus sauridae n. sp.

SPECIFIC DIAGNOSIS. *Oncodiscus* mihi; with generic characters. Strobila up to 200 mm. Testes 60–100 in each proglottis. Eggs elliptical, 0.06–0.063 × 0.039–0.042 mm.

Habitat. Small intestine of *Saurida argyrophanes.*

Locality. Inland Sea (type locality), west coast of Kyûsyû.

Date. October 24, 1928; August 17, 1930 (type date).

Type and paratypes in my collection.

14. *Parabothriocephalus gracilis* n. g. n. sp.

DESCRIPTION. This species occurs commonly in the small intestine of *Psenopsis anomala* from the Inland Sea. The body may be up to 60 mm long and 1.4 mm broad. The elongate scolex, about 0.38 × 0.12 mm, has two surficial bothria, but no definite terminal disc. The segmentation is complete throughout, although more or less incomplete in some places. Immediately behind the scolex the segments are very narrow and cuneate with salient posterior borders; in the middle part they are broadly cuneate; the gravid proglottides with less prominent posterior borders are broader than long anteriorly, but longer than broad posteriorly, varying in length and breadth from 0.5 mm to 1.4 mm. The subcuticular longitudinal musculature is well developed. The inner longitudinal fibers form a thick layer of extremely powerful bundles. The excretory stems pass medial to the nerve trunk lying just inside the dorsal muscle sheath, about one-fifth the breadth of the proglottis from the lateral edge. Ventrolateral to the nerve there are also relatively wide vessels.

The roundish testes, 70–90 in number for each proglottis, are in two lateral groups in the medullary parenchyma, bounded laterally by the nerve strands and continuous behind the ovary. The compactly coiled vas deferens lies in front of the proximal end of the cirrus pouch. The latter, 0.3–0.35 × 0.1–0.11 mm, has a very thick muscular wall composed of an inner circular and an outer longitudinal layer; it lies at about the middle of the segment to one side of the median line, with its long axis directed obliquely anteriad. The ductus ejaculatorius is strongly convoluted at the base of the cirrus pouch.

The cirrus, closely beset with long spines, opens directly in front of the vagina into the genital cloaca which in turn opens dorsally on one side a little behind the middle of the proglottis in the same plane as the nerve strand, by a relatively wide aperture surrounded by a dense cluster of subcuticular cells.

The ovary consisting of a ventral isthmus and two strongly lobulated dorsal wings lies near the posterior border of the proglottis behind the cirrus pouch, slightly displaced to the side of the genital cloaca. The germiduct arising

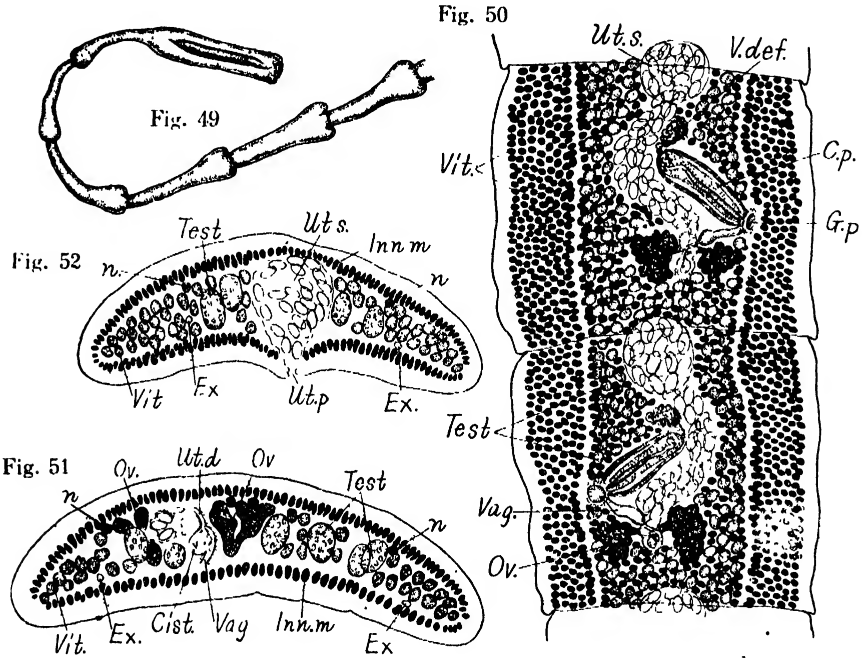

Fig. 49-52. *Parabothriocephalus gracilis*. Fig. 49. Scolex; surficial view. Type 0.38 mm long. Fig. 50. Gravid segments; dorsal view. Ca. 1.0 mm broad. Fig. 51-52. Transverse sections of gravid segment.

from the dorsal surface of the ovarian isthmus joins the vaginal duct postero-dorsal to the isthmus to form a cistern-like expansion as in bothriocephalids, and then unites with the oval vitelline reservoir. The narrow proximal part of the uterine duct passes backwards a short distance before turning back on itself to lead into the ascending uterine coils. The latter proceed forwards in the median line round the cirrus pouch to open into the large roundish uterine sac lying at the anterior end of the proglottis and encroaching a little on the preceding segment. This sac opens ventrally in the median line by a longitudinal slit. The elliptical, thin-shelled, operculate eggs are 0.075–0.087×0.039–0.048 mm, with unsegmented ova. The vagina opening into the genital cloaca directly behind the cirrus is divided into two parts, a narrow proximal duct and an elongate muscular distal sac, the base of which is closely beset with spines smaller than those of the cirrus; it is 0.13–0.16 mm long by

0.04–0.05 mm broad at the base, and lies almost transversely behind the distal half of the cirrus pouch. In some proglottides this distal part of the vagina has at about its middle a very powerful muscular constriction measuring about 0.048 × 0.025 mm. The numerous irregularly shaped vitelline masses occupy the entire lateral fields outside the nerve strands as well as the intertesticular space, and are continuous across the median line behind the ovary; they extend outwards in some places between the bundles of the inner longitudinal muscles.

Fig. 53

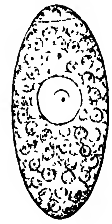

Fig. 53. Egg of *Parabothriocephalus gracilis*. 75–87 × 39–48 μ.

DISCUSSION. This worm is an aberrant bothriocephalid which is distinguished from any of the known genera of the family by the conspicuous lateral displacement of the ovary and genital pore, the armature of the cirrus and vagina, etc. I refer it to a new genus of a new subfamily, Parabothriocephalinae, to be defined later on.

Parabothriocephalus n. g.

GENERIC DIAGNOSIS. Bothriocephalidae Blanchard, 1849. Body slender, filiform anteriorly. Segmentation almost complete. Scolex elongate, small, without terminal disc, readily detachable. Anterior proglottides elongate cuneate, with salient posterior borders; middle broadly cuneate; posterior with almost parallel sides, longer than broad. Inner longitudinal musculature powerful. Testes in medulla, medial to nerve trunks. Cirrus pouch large, strongly muscular. Cirrus spinose, opening into genital atrium directly in front of vagina. Genital pore dorsal, near lateral border of proglottis, postequatorial, on right or left. Ovary bilobed, submedian (on pore side), near posterior end of proglottis. Uterine duct sigmoid in outline, almost median. Uterine sac median, roundish, encroaching on preceding segment, opening ventrally in median line by longitudinal slit. Vagina divided into narrow proximal duct and elongate muscular distal sac with spinose base. Vitelline follicles occupying entire available medullary parenchyma. Eggs thin-shelled, operculate, with unsegmented ova. Parasitic in marine fishes.

Genotype. *Parabothriocephalus gracilis*.

Parabothriocephalus gracilis n. sp.

SPECIFIC DIAGNOSIS. *Parabothriocephalus;* with generic characters. Body up to 60 mm long and 1.4 mm broad. Scolex about 0.38 × 0.12 mm. Gravid proglottides varying in length and breadth from 0.5 to 1.4 mm. Testes 70–90 in number for each proglottis. Cirrus pouch 0.3–0.35 × 0.1–0.11 mm. Eggs elliptical, 0.075–0.087 × 0.039–0.048 mm.

Habitat. Small intestine of *Psenopsis anomala*.

Locality. Inland Sea

Date. October 6, 1927; November 12, 1928 (type date); February 10, 1933.

Type and paratypes in my collection.

15. *Parabothriocephaloides segmentatus* n. g. n. sp.

DESCRIPTION. A number of this species were found associated with the preceding worm in the small intestine of *Psenopsis anomala*. The pointed anterior extremity forms an approximately cone-shaped pseudoscolex with an inconspicuous terminal disc and two surficial depressions, of which the ventral

is more pronounced than the dorsal; it may sometimes bear a pair of small lateral auricular appendages which are to be considered as the posterior borders of the first rudimentary segment. The largest specimen is 16.5 cm long and 2.5 mm in maximum breadth near the anterior end, whence the body tapers gradually backwards. Each proglottis is marked off by the fleshy collar-like projections of the posterior border, which are interrupted in the median field. The first few segments are entirely sterile, the next few show the anlage of the testes and about the tenth becomes suddenly gravid with progressive

Fig. 54

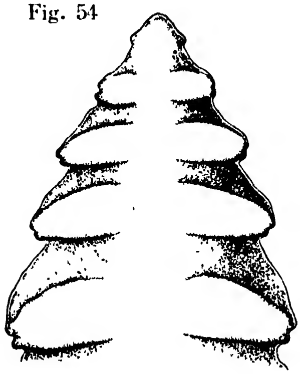

Fig. 55

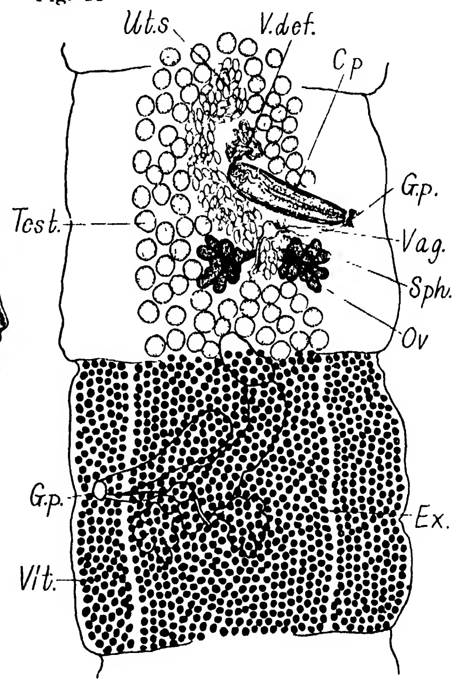

Fig. 56

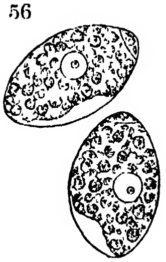

Fig. 51–56. *Parabothriocephaloides segmentatus.*
Fig. 54. Pseudoscolex; surficial view.
Fig. 55. Gravid segments; dorsal view. Ca. 2.5 mm broad. Testes and vitellaria shown in different segments.
Fig. 56. Eggs. 60–63 × 36–42 μ.

development of genitalia in the succeeding segments. Toward the posterior end of the strobila, involution of the genitalia gradually sets in and the last proglottides with the posterior borders no longer prominent are completely exhausted. The subcuticular as well as the inner longitudinal muscles are fairly well developed.

The testes, 60–80 in number, occupy the entire available space of the medulla, and are continued across the median line behind the ovary. The coiled vas deferens lies anteromedial to the proximal end of the cirrus. The spirally curved ductus ejaculatorius is expanded at the base of the cirrus pouch into

the vesicula seminalis interna. The straight cirrus is closely beset with spines as in the preceding species; it opens directly in front of the vagina into the genital atrium which in turn opens dorsally, on right or left, near the lateral margin. The elongate cirrus pouch, 0.5–0.6 mm long and placed obliquely to the long axis of the body, consists of strong inner circular and outer longitudinal muscle fibers, and is enlarged at its proximal end containing numerous coarse muscle fibers.

The submedian ovary with compact lobulated wings lies between the cirrus pouch and the posterior end of the proglottis. The uterine coils describe an approximately S-shaped curve around the cirrus pouch and lead into the capacious uterine sac lying in the median line at the anterior end of the proglottis and encroaching upon the preceding segment. The roundish, almost median uterine pore is situated at the level of the posterior end of the uterine sac. The oval to elliptical, thin-shelled, operculate eggs measure $0.06–0.063 \times 0.036–0.042$ mm; the ova are not segmented. The vagina opening immediately behind the cirrus passes inwards almost transversely behind the cirrus pouch, near the middle of which it has a powerful sphincter and then suddenly expands into a very conspicuous sphere 0.07–0.1 mm in diameter. The narrow ductus seminalis is strongly recurved before joining the germiduct. The extremely numerous vitelline follicles are diffusely distributed in the cortical parenchyma.

The wide thin-walled ventral and a narrow thick-walled dorsal main excretory trunks lie just inside the genital pore, forming the lateral boundaries of the testes.

Discussion. This worm is also an aberrant bothriocephalid characterized by the presence of a pseudoscolex, the unusual development of proglottides and genitalia, the well developed vaginal sphincter, the cortical distribution of vitellaria, etc. In these respects it differs fundamentally from *Parabothriocephalus* though closely allied in other characters. From the topography of the genitalia it seems likely that this new genus belongs to Parabothriocephalinae.

Parabothriocephaloides n. g.

Generic Diagnosis. Bothriocephalidae Blanch., 1849. Pseudoscolex cone-shaped, with surficial depressions. No neck. Strobila pointed at both extremities, broadest near anterior end, with prominent posterior borders except in median field. Testes in medulla, between excretory trunks. Cirrus pouch strongly muscular, large. Cirrus spinose, opening into genital atrium directly in front of vagina. Genital pore dorsal, equatorial, near lateral border of proglottis, not regularly alternate. Ovary bilobed, submedian, on atrial side, near posterior end of proglottis. Uterine coils S-shaped in outline, almost median. Uterine sac median, roundish, invading preceding segment, with roundish ventral opening at its posterior end. Vagina with powerful sphincter and large seminal receptaculum. Vitelline follicles cortical, diffuse. Eggs thin-shelled, operculate, with unsegmented ova. Parasitic in marine fishes.

Genotype. *Parabothriocephaloides segmentatus*.

Parabothriocephaloides segmentatus n. sp.

Specific Diagnosis. *Parabothriocephaloides;* with generic characters. Body up to 16.5 cm long and 2.5 mm broad. Testes 60–80 in number, continuous behind ovary. Cirrus pouch 0.5–

0.6 mm long, enlarged at proximal end. Ductus ejaculatorius spirally curved, expanded at base of cirrus pouch. Ovarian wings compact, lobulated. Eggs 0.06–0.063 × 0.036–0.042 mm.

Habitat. Small intestine of *Psenopsis anomala.*

Locality and date. Inland Sea; Nov. 29, 1932.

Type and paratypes in my collection.

Parabothriocephalinae n. subfam.

SUBFAMILY DIAGNOSIS. Bothriocephalidae Blanchard, 1849. Scolex with two surficial bothria or pseudoscolex. Strobila distinctly segmented. Inner longitudinal musculature well developed. Excretory stems, nerve cord and dorsal genital pore in outer fourth of proglottis. Testes in medulla, between nerve cords. Cirrus pouch strongly muscular. Cirrus spinose. Ovary bipartite, a little to atrial side. Uterine sac anterior, median, opening ventrally. Eggs thin-shelled, operculate, with unsegmented ova. Vagina posterior to cirrus pouch, with or without sphincter. Vitellaria in medulla or cortex.

TRIAENOPHORIDAE Blanch., 1849

16. *Anchistrocephalus microcephalus* (Rud., 1819) Montic., 1890

This species is very common in the intestine of Japanese *Mola mola.* Since it has already been described by Monticelli, Matz, Yoshida, etc., I will make here only a few supplementary remarks on anatomical details.

The rose-thorn-shaped marginal hooks of the terminal disc are closely set in about ten alternating rows on the bothrial side but a little more sparsely on the lateral, abruptly diminishing in size posteriorly; the largest anterior hooks measure about 0.036 × 0.015 mm with the exception of the basal plates which is 0.03–0.04 mm in diameter.

Fig. 57

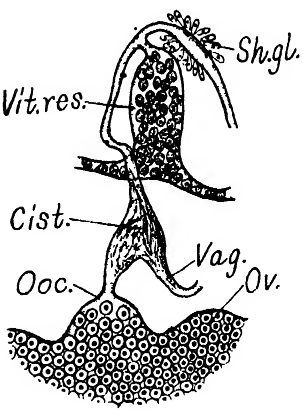

Fig. 57. Female genital complex of *Anchistrocephalus macrocephalus* (Rud., 1819).

The nerve strands lie lateral to the excretory stems in the proglottides but come to lie medial to them in the apex of the scolex where they form the central ganglion. The excretory system of the proglottides consists of a relatively thick-walled dorsal or dorsomedial and a larger ventral stem giving off numerous anastomosing branches; in the scolex, however, there is a single pair of narrow stems communicating with the superficial plexus of the bothria.

The testes occupying the greater ventral medullary parenchyma medial to the nerve strands are barely continuous across the median line as are the vitelline follicles between the uteri of the two consecutive segments. The vas deferens is strongly convoluted, contrary to Braun's diagnosis. The protrusible cirrus is lined by transversely striated cuticular folds not mentioned by Matz, Yoshida, etc.

The vagina passes in a proximally somewhat sinuous course toward the oocapt to join the germiduct. Yoshida's description and figure (fig. 2) represents

it as making several turns in the median line before uniting with the germiduct, but there is no doubt that he mistook the uterine anlage for the vagina, because the section on which his figure is based was obviously taken from an immature segment. In this respect and in other details Matz's figure 19 is very accurate, though somewhat diagrammatic. The short narrow germiduct arises from the oocapt in the median line on the dorsal surface of the ovary, and soon enlarges to form a cistern at its junction with the vagina, then joining the vitelline reservoir as shown in figure 57. The shell gland cells are very poorly developed as in Matz's specimens. The oval, relatively thick-shelled, operculate eggs are 0.06–0.063 × 0.042–0.045 mm; the contained ova are not segmented.

As regards the extent of the vitelline follicles I agree entirely with Braun.

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17. *Fistulicola plicatus* (Rud., 1819) Lühe, 1899

DESCRIPTION. This peculiar worm was found in the large intestine of *Xiphias gladius* Linn. at Kuki. The longest alcoholic specimen consisting of several hundred segments measures 110 × 5 mm and a contracted one 62 × 12 mm. In larger specimens the scolex is deeply imbedded in the abnormally thickened intestinal wall of the host and usually strongly deformed, so that its normal shape can be made out only in young worms. The scolex is 2.1 mm long by 1.3 mm thick, with two surficial bothria and a very muscular terminal disc measuring 1.0 × 0.32 mm, behind which there is a distinct constriction. The short unsegmented neck region is about 0.8 mm broad. The proglottides are strongly compressed anteroposteriorly and their conspicuously laminated borders project almost transversely, so that the worm appears "durchblättert" in the sense of German authors.

The cuticle is relatively thick, with the underlying circular and longitudinal muscle fibers well developed. The powerful inner longitudinal muscles passing through the network of transverse and dorsoventral muscle fibers form a very thick sheath, which gradually becomes thinner posteriorly. In the medullary parenchyma bordered by transverse muscles there are numerous dorsoventral fibers running through the muscle sheath mentioned above to the basement membrane of the cuticle. The nerve trunk and the main excretory vessel with a relatively thick wall lie near together in the lateral medulla.

The numerous testes occupy all the available space of the medulla dorsal to the uterus and lateral to the nerve trunk. The compactly coiled vas deferens on the anterodorsal side of the ovary reaches to the antiporal end of the

ovary; distally the coils are rather loose and the thick muscular wall is beset with cuticular bristles, like the ductus ejaculatorius which is more or less expanded at the base of the cirrus pouch. The very stout protrusible cirrus is strongly constricted near its base and opens irregularly on the right or left margin under the lamella of the preceding segment. The small muscular cirrus pouch, about 0.07–0.08 mm thick, extends to the lateral edge of the muscle sheath.

The median ovary lying ventrally in the medulla consists of numerous small acini closely massed in a transversal plane. The narrow germiduct arising from the oocapt passes only a short distance toward the pore side and then turning dorsad forms a conspicuous cistern at the junction with the vagina, whence it proceeds again to the pore side and receives the duct from the vitelline reservoir. The vagina and the efferent duct of the vitelline reservoir open into the germiduct from the antiporal side. The proximal uterine duct surrounded by relatively small numbers of shell gland cells passes along the ventral muscle sheath toward the oocapt and there describes a few turns before leading into the uterus. The spacious uterus, divided into many compartments by dorsoventral parenchymatous septa, occupies the greater part of the ventral medulla, and extends farther laterally on the pore side than on the other. The distal compartment of the uterus lies on the pore side lateral or ventrolateral to the excretory stem and medial to the nerve trunk; on the ventral side it gives rise to a short sagittal duct, about 0.24 mm long by 0.04 mm wide and provided with coarse inner longitudinal (dorsoventral) and outer circular muscle fibers. This duct forms a small atrium-like dilatation lined by cuticle before opening externally. The ventral uterine pore lies on the pore side between the excretory and the nerve trunks, and is covered up by the lamella of the preceding segment. The elongate oval, light brown, operculate eggs are thick-shelled and measure 0.096–0.1 × 0.051–0.054 mm*, but the lighter colored immature ones are 0.102–0.105 × 0.057–0.072 mm*; the contained ova are not segmented. The small vitelline follicles form a flat layer throughout. The oval vitelline reservoir lies very near the oocapt on its pore side. The vagina opening directly anteroventral to the cirrus has at its distal end a powerful sphincter about 0.17 mm in diameter; it runs inwards in a spiral course and then passing dorsal to the terminal compartment of the uterus comes to lie just inside the ventral muscle sheath, along which it describes sinuous transverse curves. Dorsally it extends to the antiporal end of the ovary and bends back on itself to meet the germiduct.

AMPHICÓTYLIDAE Ariola, 1899

18. *Abothrium rugosum* (Goeze, 1782) Lönnberg, 1889

This cosmopolitan species has been reported by various authors and its anatomy has been well studied by Moniez, Lönnberg, Linton and Nybelin. It

*Measurements were made in water on eggs fixed in 70% alcohol.

is also very common in *Gadus macrocephalus* Tilesius and *Theragra chalcogramma* (Pallas) from Toyama Bay.

I have nothing to add to Nybelin's very accurate description except a few remarks on the eggs. According to Nybelin the eggs containing fully developed embryos are about 0.08–0.1 mm in diameter, while Linton found collapsed, unstained eggs to be 0.027 mm long by 0.016 mm broad and another very thin-shelled, transparent one 0.02 × 0.016 mm. I have convinced myself that this remarkable difference in the egg size is due to different degrees of development. Fixed in alcohol and measured in water, the largest subglobular eggs are 0.1 × 0.093 mm and the smallest 0.03 × 0.023 mm. The fully developed, elliptical embryos measure 0.051–0.057 × 0.039–0.018 mm and bear at the broader end three pairs of slender hooks about 0.02 mm long; between the shell and the delicate yolk-membrane (Hüllmembran of Schauinsland) with scattered nuclei there is a more or less wide cavity, which is almost unrecognizable, if at all, in the youngest eggs. The innermost membrane, Ektoblast of Schauinsland, is at first closely applied to the surface of the embryo, but in fully matured embryos it is separated by the intervening translucent fluid. There are a number of spine-like structures, not mentioned by earlier workers, on the surface of the yolk-membrane of mature eggs. The knob-like thickening of the egg shell as observed by Schauinsland cannot be recognized in my material.

Fig. 58

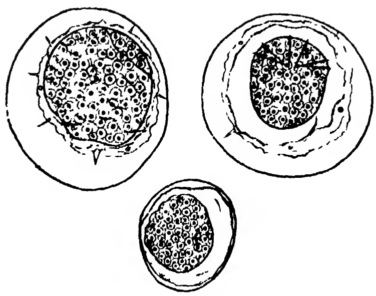

Fig. 58. Eggs of *Abothrium rugosum* (Goeze, 1782). 0.03–0.1 × 0.024–0.093 mm.

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Echinophallidae Schumacher, 1914

19. *Echinophallus japonicus* n. sp.

Description. This tapeworm occurs not uncommonly in the pyloric appendages of *Psenopsis anomala* from the Inland Sea. The fleshy body, up to 5 cm in length and 8.5 mm in breadth, undergoes a twist by the hypertrophy of the

lateral edges. The true scolex found in a specimen 4.0 mm long is plump, 0.44×0.2 mm, truncate in front, broadened posteriorly, and bears shallow surficial bothria and an inconspicuous terminal disc. The mature worms bear instead of the true scolex an approximately trapezoidal pseudoscolex with surficial depressions. In young examples the posterior extremity is sharply pointed but in adults it is conspicuously notched, because the terminal segments have been lost. The posterior borders of the first few segments project both dorsally and ventrally in the form of an epaulette-like appendage which tends to broaden posteriorly into a collar. Farther posteriorly the posterior borders are divided both dorsally and ventrally into a number of tongue-shaped lappets, broader and shorter on the ventral than on the dorsal side.

Of the longitudinal musculature the inner layer is extremely strong and the outer poorly developed. The transverse muscle fibers form an inconspicuous layer inside as well as outside the inner longitudinal musculature. The dorsoventral and the medullary transverse fibers are not numerous. The main excretory vessel passes ventral to the cirrus pouch and vagina.

The testicles, about 60-70 in number for each proglottis, lie in the medulla medial to the ovary, mainly in the posterior half of the proglottis and leaving the median field free. The vas deferens is closely coiled before entering the cirrus pouch. The latter is a large muscular organ composed of powerful inner circular and outer longitudinal fibers; in the type it appears first in the eighth segment with the size of 0.6×0.1 mm; in mature segments in which it is $0.35-0.48 \times 0.15-0.2$ mm, it is pressed on by the reproductive organs, and its long, otherwise almost transverse axis forms an acute angle with the longitudinal axis of the strobila, with its proximal end slightly deflected laterad. The ductus ejaculatorius is twisted. The protrusible cirrus is closely beset at the base with strong spines, about 0.057×0.01 mm in maximum size and slightly recurved near the pointed end; it protrudes dorsally from the genital atrium near the lateral margin on both sides of the strobila just behind the middle of the proglottis. The prostatic cells as observed by Schumacher in *Echinophallus wageneri* (Montic., 1890) are absent.

The strongly lobulated ovary is situated near the posterior end of the proglottis just behind the proximal end of the cirrus pouch, with its middle part adjoining the ventral transverse muscle layer underlying the inner longitudinal musculature. The germiduct arising from the oocapt on the dorsal side of the middle part of the ovary joins the ductus seminalis to form the cistern, dorsal to which it describes a sinuous curve and then receives the duct from the vitelline reservoir. The shell gland cells are not well developed. The vagina opening into the genital atrium directly behind the cirrus is divided into three parts: the straight distal part is lined by cuticle; the middle is more or less convoluted and distended with spermatozoa at its junction with the narrow proximal part which forms the ductus seminalis. The proximal part of the uterus, coiled medial to the cirrus pouch, leads into the uterine sac lying a little nearer to the median line than to the lateral margin of the proglottis. The uterine sac with a weakly developed muscular wall opens ven-

Fig. 59

Fig. 63

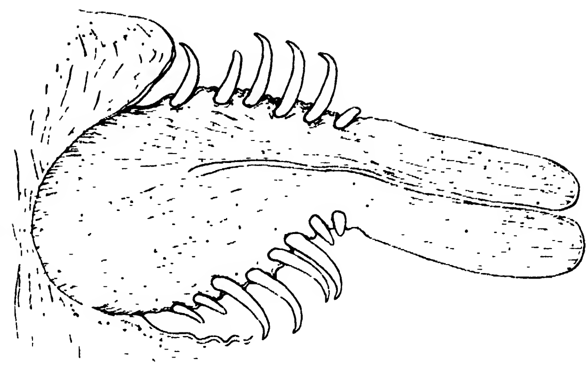

Fig. 61

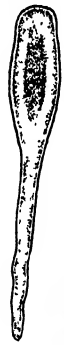

Fig. 62

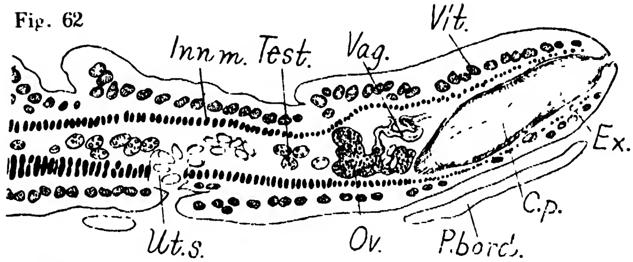

Fig. 64

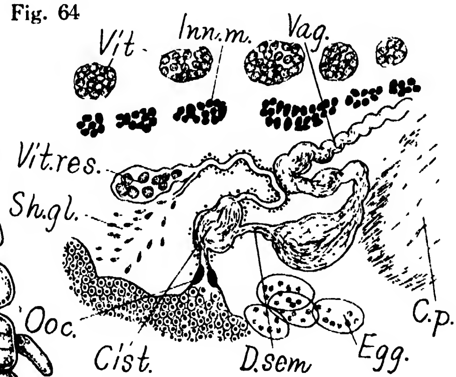

Fig. 65

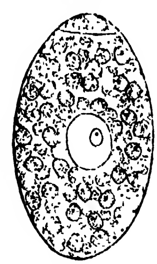

Fig. 60

Fig. 59-65. *Echinophallus japonicus.*

Fig. 59. Pseudoscolex; dorsal view. Type.

Fig. 60. Young form with primary scolex; ventral view. 4.0 mm long.

Fig. 61. Plerocercoid. 0.45×0.075 mm.

Fig. 62. Transverse section of gravid segment showing its lateral half.

Fig. 63. Cirrus.

Fig. 64. Female genital complex.

Fig. 65. Eggs. 54-60×33-35 μ.

trally between the bundles of the inner longitudinal muscles near the anterior border of the proglottis; it is often overlapped by the lappet of the posterior border of the preceding segment. The elliptical, thin-shelled, operculate eggs, fixed in alcohol and measured in water, are 0.054–0.06 × 0.033–0.035 mm; the contained ova are not segmented.

The extremely numerous vitelline follicles fill up the entire cortical parenchyma, intruding a little into the medulla through the inner longitudinal muscle layer at the lateral margins of the proglottis and also into the lappets of the posterior borders.

It is very interesting to note that larvae of this species were found associated with the adults. The smallest is elongate club-shaped, tapering posteriorly, and measures 0.45 × 0.075 mm; the scolex, 0.2 × 0.075 mm and truncate in front, bears two inconspicuous bothria and a terminal disc; the calcareous corpuscles are very numerous throughout the body; the segmentation is not yet recognizable. In another larva measuring 0.66 × 0.088 mm, the segmentation is clearly indicated.

DISCUSSION. This species differs chiefly from *Echinophallus wageneri* (Montic., 1890) in the extent of the vitellaria. Schumacher erroneously states that the eggs are always devoid of operculum.

Echinophallus japonicus n. sp.

SPECIFIC DIAGNOSIS. *Echinophallus* Schumacher, 1913. Body up to 50 × 8.5 mm. Scolex about 0.44 × 0.2 mm in immature worms. Pseudoscolex trapezoidal, with surficial depressions. Posterior borders of proglottides conspicuously indented or lobed. Testes 60–70 in number for each proglottis, medial to ovary, discontinuous in median line. Cirrus spines with slightly recurved pointed end. Ovary strongly lobulate. Vitelline follicles occupying entire cortical parenchyma. Eggs elliptical, 0.054–0.06 × 0.033–0.035 mm, containing unsegmented ova.

Habitat. Pyloric appendages of *Psenopsis anomala*.

Locality and date. Inland Sea; October 6 and 12, 1927; November 12, 1928 (type date). Type and paratypes in my collection.

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DIPHYLLOBOTHRIIDAE Lühe, 1910

20. *Digramma alternans* (Rud., 1810) Cholodkovsky, 1915

This species has been confused by various authors with *Ligula intestinalis* (Linn.) but is quite distinct from it.

I owe my material to Dr. Miyadi who found it on April 27, 1928, in the body cavity of *Cyprinus carassius* Linn. from Lake Biwa. The largest specimen, as preserved in alcohol, is about 55 cm in length and 15 mm in maximum breadth in front of the middle. The terminal bothrium is usually a short groove running across the tip, but in the largest specimen mentioned above it is flanked

by prominent lips. The surface of the body is marked on the dorsal and ventral sides by two shallow, parallel, submedian grooves 3-5 mm apart from each other, the ventral ones being more conspicuous, besides a median groove on the ventral surface. In the anterior part of the body the lateral margins are somewhat folded.

The cuticle, 0.025–0.039 mm thick, appears homogeneous under low magnification, but has a pseudociliated structure, and rests on a very distinct basement membrane. The subcuticular cells form a thick compact layer under the fairly well developed subcuticular longitudinal muscles. The very thick inner longitudinal muscle sheath consists of strong bundles of irregular outline in cross section. The transverse musculature forms a very conspicuous layer inside the muscle sheath.

The nerve trunk, about 0.08–0.09 mm in diameter, lies in the middle of each lateral half of the strobila. The excretory system is best developed in the cortical parenchyma as a plexus between the subcuticular cell layer and the vitellaria. Whether the genitalia are single and alternate or double for each proglottis, I cannot determine, because they are very closely crowded on either side of the median plane, but the second alternative seems more probable. The ellipsoidal testes with the greatest dorsoventral diameter lie in a single row on the dorsal side of each lateral half of the medulla, interrupted in the

Fig. 66

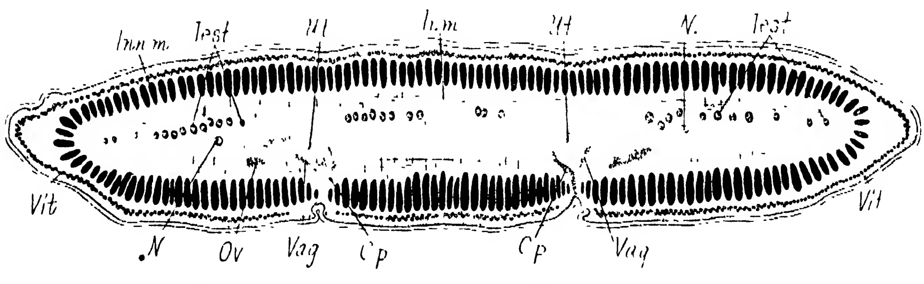

Fig. 66. Transverse section of larval *Digramma alternans* (Rud.).

submedian field. The anlage of the male terminal duct surrounded by a dense coat of cells lies medial to that of the vagina, and opens along with the latter into the common genital cloaca, which in turn opens to the exterior in each ventral submedian groove described above. The elongate ovarial acini are situated on the ventral side of the medulla between the nerve cord and the cloacal plane. The uterine anlage describes a loose curve parallel and dorsal to the vagina, and appears to open lateral to the vagina. There is no alternation of the three genital openings as pointed out by Cooper. The specific names *digramma* and *alternans* are probably derived from the double or alternate opening of the genital cloaca. The vitellaria form an uninterrupted, thin layer under the cortical plexus of the excretory system.

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PROTEOCEPHALIDAE La Rue, 1911

21. *Proteocephalus parasiluri* n. sp.

DESCRIPTION. This tapeworm was found in the small intestine of *Parasilurus asotus* from Lake Ogura. Unfortunately the scolex was lost at the time of dissection, so that its description is based on a larval form obtained from the same habitat.

The worm was separated into pieces after lying in tap water for a few hours. The isolated proglottis was biscuit-shaped owing to strong contraction at both ends in the median line. The total length of the strobila could not be ascertained.

The scolex is approximately globose and 0.8 mm broad with a prominent apical sucker 0.1 mm in diameter. The four small cup-shaped suckers, 0.17–0.2 mm in diameter, are situated just in front of the broadest part of the scolex, and separated from each other by longitudinal furrows extending backwards into the neck. The unsegmented neck region is 0.33 mm broad. The middle proglottides are 0.15–0.32 × 0.8–1.1 mm and the posterior 0.43–1.25 × 1.1–1.85 mm. The inner longitudinal muscle sheath and the dorsoventral muscles are well developed.

The testicles, about 180 in number, occupy the greater median part of the medulla, with their long axes directed transversely. The vas deferens extending from the median line to the middle of the lateral half of the proglottis is strongly convoluted in front of the middle of the proglottis. The thin-walled cirrus pouch is about 0.5 × 0.13 mm. The ductus ejaculatorius and the proximal part of the cirrus are coiled several times at the base of the cirrus pouch. The distal end of the cirrus is conspicuously broadened (about 0.06 mm in diameter) in the form of a trumpet. The outer longitudinal muscle fibers of the cirrus are far more powerful than the inner circular ones. The cirrus is surrounded by a dense coat of gland cells, and when everted, may be as long as 1.0 mm; it opens directly in front of the vagina into the genital atrium which in turn opens on the right or left margin just in front of the middle.

The bilobed ovary, 0.35 × 1.3 mm, lies at the posterior end of the proglottis, and its strongly lobulated compact wings extend to the vitellarian fields. The well developed shell gland lies posterodorsal to the ventral isthmus of the ovary lying in front of the coiled uterine duct. The median stem of the uterus extends the whole length of the proglottis and gives off a number of side branches reaching as far outwards as the ovarian wings. There is ample indication of the uterine stem breaking through the ventral median wall of the body. The subglobular, thin-shelled eggs, fixed in alcohol and measured in water,

are 0.027–0.033 × 0.027–0.03 mm. The vitelline follicles are closely massed in two marginal bands, separated from the testes by the excretory trunks. The paired transverse vitelline ducts pass along the ventral surface of the ovary near its posterior margin. The vagina forms a spindle-shaped expansion just before crossing the proximal end of the cirrus pouch on its ventral side and opens immediately behind the cirrus.

The paired excretory trunks consist of a wide thin-walled ventral and a narrow dorsal vessel, both running just inside the inner muscle sheath between

Fig. 67

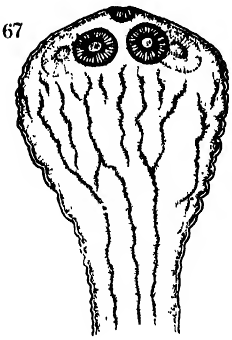


Fig. 72

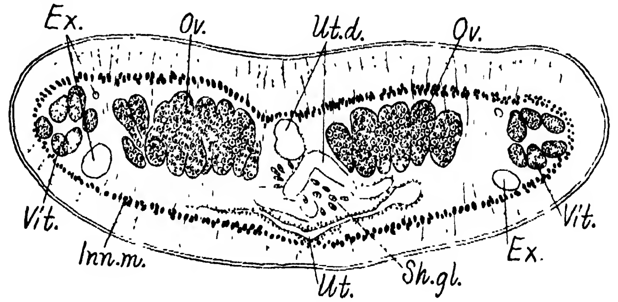


Fig. 68

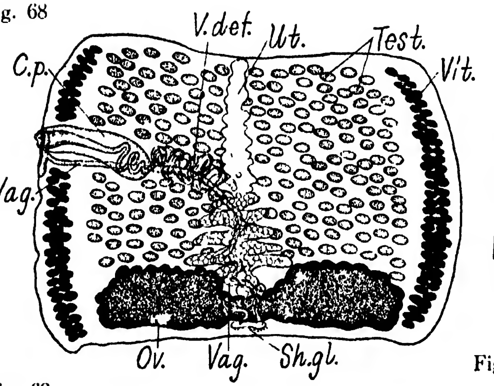


Fig. 70

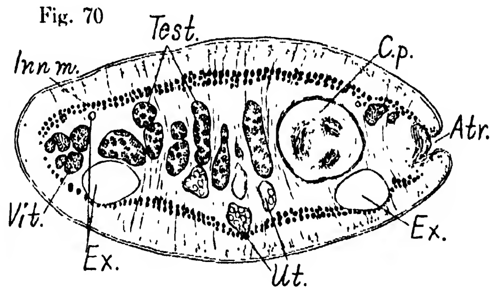
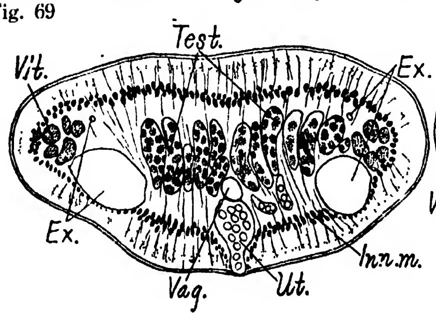


Fig. 71

Fig. 69



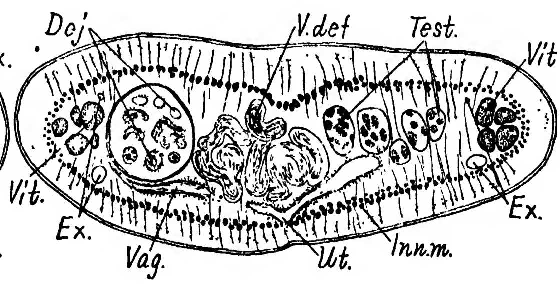


Fig. 67–72. *Proteocephalus parasiluri*. Fig. 67. Scolex; surficial view. Type 0.8 mm broad. Fig. 68. Gravid segment. 1.25×1.85 mm. Fig. 69–72. Transverse sections at various levels.

the vitellaria and the testes.

The nerve trunk lies on each side dorsal to the cirrus and vagina, between the muscle sheath and the vitellaria, partly surrounded by the latter.

LARVA. The plerocercoid larva of this species was found in the large intestine of *Mogurnda obscura* from Lake Ogura on May 14, 1928, and on January 14, 1932, as well as in the small intestine of *Gnathopogon elongatus* from Lake Biwa on March 13, 1932. On January 14, 1932, I fed a few larvae to a catfish, the host fish for the adult worm, which had been kept in the experimental tank for more than three months. Twenty days later the catfish was killed and a single active larva was recovered from the intestine. Whether this larva was one of those used in the experiment or came from nature (spontaneous infection previous to experiment), I cannot determine, but even if the second alternative be true, it can safely be inferred that the larva does not develop further during the winter, although lodged in an appropriate host. From the morphological and ecological point of view, however, it is almost certain that the proteocephalid plerocercoid from *Mogurnda obscura* and *Gnathopogon elongatus* is the larval form of the present species. I hope to be able to give conclusive evidence in a later communication. Here will be given only a detailed account of the excretory system in living material.

There are two main trunks on either side of the body, a wide ventral and a narrow dorsal. Both pairs are connected with each other by means of a ring at the base of the apical sucker. Behind the suckers the ventral trunks give off a number of medial anatomosing branches; posteriorly they send out side branches at intervals both inwards and outwards and finally unite to form at the posterior end of the body a broadly communicating plexus with a single terminal aperture. The rather simple dorsal trunks reaching to the extreme posterior tip of the body are also connected by a transverse commissure at about the same level with the posterior communication of the ventral trunks.

DISCUSSION. This species is characterized by the possession of a well developed fifth sucker, the large number of testes, the vagina lying behind the cirrus pouch, etc. In these respects it comes near *Proteocephalus pentastoma* (Klaptocz, 1906) according to La Rue's key. The specific diagnosis is reserved until additional specimens are available.

22. *Proteocephalus plecoglossi* n. sp.

DESCRIPTION. A few specimens of this species were found on March 23, 1928, in the upper portion of the small intestine of *Plecoglossus altivelis* from Lake Biwa. The type, not yet fully ripe, is about 2.0 cm long by 0.54 mm broad. The scolex, about 0.25 mm broad, bears four suckers 0.1 mm in diameter and a feebly developed apical sucker measuring 0.057×0.021 mm. The segmentation is evident. The unsegmented neck part is present. The anterior proglottides are definitely broader than long, while the gravid ones are quadrate or slightly longer than broad. The last segment, broadly pointed posteriorly, is 0.58×0.38 mm. The surface of the body is covered by a thick two-layered

cuticle, the outer layer appearing densely ciliated and the inner entirely homogeneous. The subcuticular circular and longitudinal musculature is not well developed, but the underlying cells form a very thick compact layer. The inner longitudinal muscle sheath is rather poorly developed.

Fig. 74

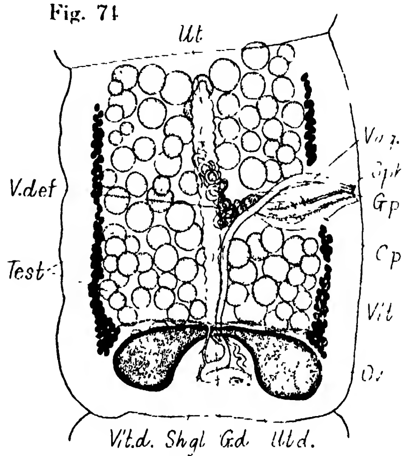


Fig. 73

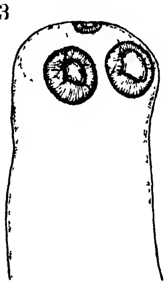


Fig. 75

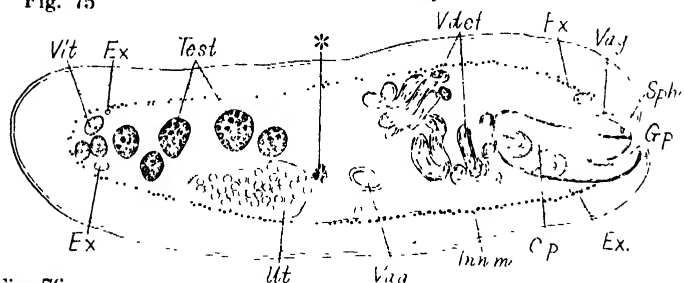


Fig. 76

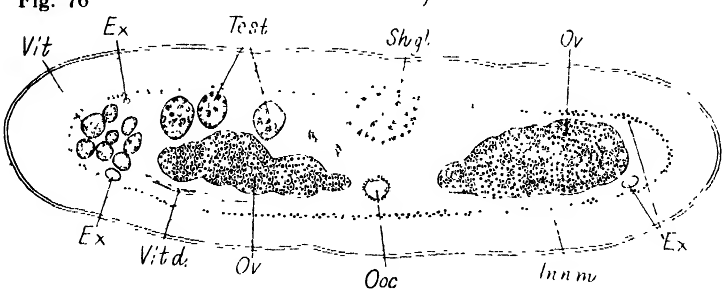


Fig. 73–76. *Proteocephalus plecoglossi.* Fig. 73. Scolex; surficial view. Type 0.25 mm broad. Fig. 74. Mature segment; ventral view. 0.54 mm broad. Fig. 75–76. Transverse sections. * Opening of uterine duct into uterus.

The testes, about 80–100 in number for each gravid proglottis, lie close together in the medullary parenchyma dorsal to the uterus between the vitellarian fields. The compactly coiled vas deferens lies between the median line and the proximal end of the cirrus pouch; its distal end has a muscular wall

similar to that of the once or twice coiled ductus ejaculatorius in the cirrus pouch. The cirrus is lined by extremely fine folded cuticle and surrounded by a dense coat of gland cells; it opens ventral to the vagina into the genital atrium on the right or left margin in front of the middle of the proglottis. The muscular cirrus pouch, about 0.15–0.2 mm long, extends one-third or a little less across the breadth of the proglottis.

The ovary at the posterior border of the proglottis consists of a ventral isthmus and two compact lateral wings extending to the posterior ends of the vitellaria. The germiduct originating from the oocapt at the middle part of the ovarian isthmus joins the vagina lying dorsal to the isthmus and then the vitelline reservoir. The uterine duct is surrounded at its proximal end by the compact shell gland, and after describing a few turns posterodorsal to the isthmus, passes forwards along the vagina to open into the median stem of the uterus from the dorsal side at about the middle of the proglottis. The uterine stem gives off a number of lateral out-pocketings filled with eggs. The onchospheres measure in sections about 0.016 mm in diameter.

The vitelline follicles are in two relatively narrow lateral bands extending the whole length of the proglottis, just inside the inner longitudinal muscle sheath. The paired transverse vitelline ducts lie just in front of the ovary. The vagina, distinctly ciliated throughout its course contrary to La Rue's observation, runs inwards in front of the cirrus pouch and then crosses the proximal end of the cirrus pouch on its ventral side; its distal part is surrounded by numerous gland cells and a weak sphincter is present around its opening.

The excretory as well as the nervous system is of the usual proteocephalid type (cf. preceding species).

DISCUSSION. This species has been provisionally identified by Kataoka and Momma with *Proteocephalus neglectus* La Rue, 1911, but differs from it in the absence of the genital papilla, the coiled ductus ejaculatorius, the size of the cirrus pouch and onchosphere, the position of the sphincter vaginae, etc.

Proteocephalus plecoglossi n. sp.

SPECIFIC DIAGNOSIS. *Proteocephalus* Weinland, 1858. Strobila slender, 2.0 cm or more, distinctly segmented. Scolex with feebly developed apical sucker. Neck present. Anterior proglottides broader than long, posterior quadrate or slightly longer than broad. Genital pore preequatorial, irregularly alternate. Testes 80–100 in number. Cirrus pouch extending one-third or less across breadth of proglottis. Cirrus ciliated? Ductus ejaculatorius coiled once or twice. Vagina ciliated throughout, opening dorsal to cirrus, with weak sphincter around its aperture. Ovarian wings compact. Vitellaria narrow. Onchosphere about 0.016 mm in diameter in sections.

Habitat. Small intestine of *Plecoglossus altivelis*.

Locality and date. Lake Biwa; March 23, 1928.

Type and paratypes in my collection.

23. *Gangesia parasiluri* n. sp.

DESCRIPTION. This species was found in the small intestine of *Parasilurus*

asotus from Lake Ogura and Toyama Prefecture. The type, the largest of all my specimens, measures about 40 mm in length and 1.0 mm in maximum breadth, which is that of a ripe posterior segment. The scolex 0.33 mm broad has a very prominent muscular terminal disc and four thin-walled suckers 0.14 mm in diameter, with numerous spinelets on the anterior border. The terminal disc, 0.125 × 0.175 mm, bears on its margin a single circle of 37 hooks, all similar in shape, about 0.02 mm long and consisting of a slightly recurved point and an irregularly rounded base, as shown in fig. 77. The unsegmented neck region is about 3.2 mm long and 0.26 mm broad just behind the scolex. The first segments are several times as broad as long, the middle quadrate and

Fig. 77

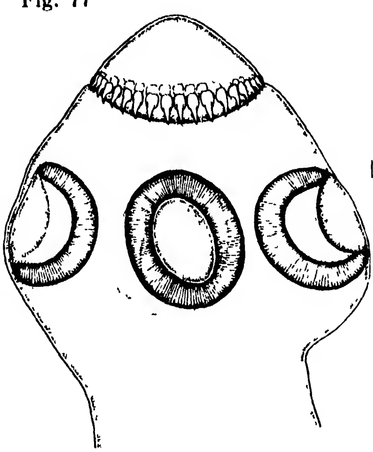


Fig. 78

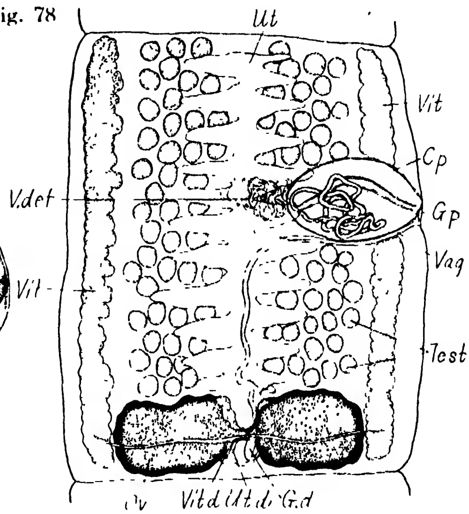


Fig. 77-78. *Gangesia parasiluri.*
Fig. 77. Scolex. 0.24 mm broad.
Fig. 78. Mature proglottis; ventral view. Type 1.25 × 1.0 mm.

the posterior longer than broad. The inner longitudinal muscles are poorly developed, especially in the posterior proglottides.

The testes, 90-100 in number, lie in the medullary parenchyma anterior to the ovary between the excretory stems of the two sides, tending to atrophy as the segments become gravid. The closely coiled vas deferens lies between the median plane and the cirrus pouch. The ductus ejaculatorius is much convoluted. The cirrus surrounded by numerous glandular cells may attain a considerable length when protruded. The oval to elliptical cirrus pouch measures 0.375 × 0.225 mm when at rest and 0.3 × 0.2 mm when the cirrus is fully protruded.

The relatively large ovary is strongly lobulated and extends laterally to the posterior ends of the vitellaria. The shell gland complex lies posterodorsal to the mid-piece of the ovary as in *Proteocephalus*. The uterine diverticula are not more than twenty. The eggs could not be measured on account of poor preservation. The narrow vagina opens in front of or behind the cirrus

into the genital atrium which in turn opens in front of the middle of the right or left margin of the proglottis. The well developed vitellaria fill up the interspace between the lateral edges of the inner muscle sheath and the excretory trunks.

The dorsal and ventral excretory trunks of one side are connected with those of the other just behind the suckers, and also with each other under the terminal disc by a dorsoventral anastomosis.

VARIATION. The number of hooks on the margin of the terminal disc varies from 32 to 37.

DISCUSSION. This species resembles *Gangesia agraensis* Verma, 1928, more closely than any other species, but differs from it distinctly in the number of the uterine diverticula and of the marginal hooks of the terminal disc as well as in the number of spinelet rows on the suckers. *Tetracampos* Wedl which cannot be identified with *Gangesia* Woodland if Wedl's description is correct, should in my opinion be regarded as a doubtful genus until the original specimens are sufficiently worked out.

Gangesia parasiluri n. sp.

SPECIFIC DIAGNOSIS. *Gangesia* Woodland, 1924. Strobila up to 40×1.0 mm, distinctly segmented. Scolex 0.33 mm broad. Suckers 0.14 mm in diameter, fringed with several rows of spinelets on anterior border. Terminal disc muscular, 0.125×0.175 mm, with a single circle of 32–37 hooks about 0.02 mm long and consisting of a slightly recurved point and an irregularly rounded base. Neck 3.2×0.26 mm. Gravid proglottides square or longer than broad, with almost parallel sides. Testes 90–100. Ductus ejaculatorius much convoluted. Cirrus pouch oval to elliptical, about one-third as long as the proglottis is broad. Cirrus very long when everted, opening in front of or behind vagina. Genital pore irregularly alternate. Ovary compact, with lobulated outline. Uterine diverticula not more than twenty.

Habitat. Small intestine of *Parasilurus asotus*.

Locality. Toyama Prefecture (type locality), Lake Ogura.

Date. October 29, 1929 (type date); November 14 and December 12, 1931.

Type and paratypes in my collection.

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PHYLLOBOTHRIIDAE Braun, 1900

24. *Phyllobothrium marginatum* n. sp.

DESCRIPTION. This tapeworm was obtained from the spiral intestine of *Squatina japonica* Bleeker from Toyama Bay. It measures up to 6.0 cm in

length and 0.8 mm in breadth. The scolex bears four, very large, almost sessile bothridia with crenulated, conspicuously thickened, muscular margin. The accessory sucker, 0.08 mm in diameter, lies at the anterior end of each bothridium. The slender neck is about 13 mm long. The mature segments are 0.7–1.6 × 0.53–0.8 mm and the detached gravid ones 2.5–3.2 × 0.87–1.1 mm; both are con-

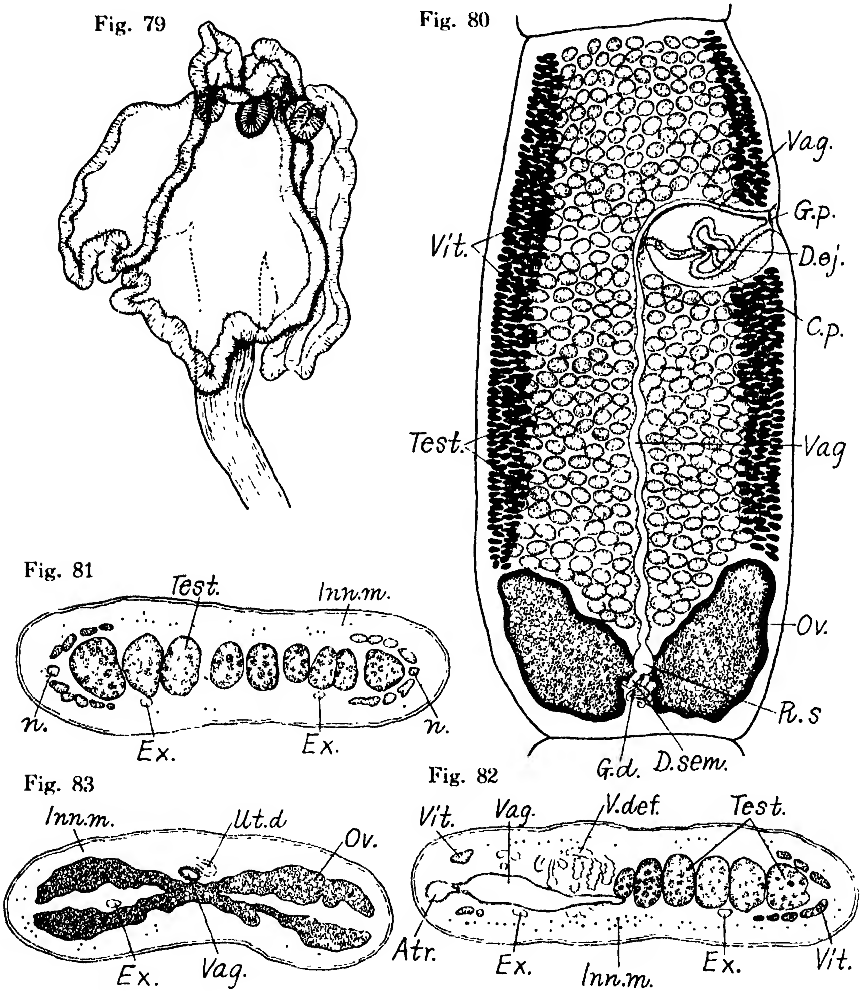

Fig. 79–83. ***Phyllobothrium marginatum.*** Fig. 79. Scolex. Fig. 80. Mature segment; dorsal view. Type 1.6×0.8 mm. Fig. 81–83. Transverse sections of mature segment.

stricted at the segmentation line. The posterior borders of each segment are smooth and not prominent.

In mature or gravid segments the inner longitudinal muscular bundles pass through the thick layer of subcuticular cells without forming a definite sheath, but in the neck region they are fairly well developed. There are very delicate

transverse muscle fibers between the spongy medulla and the compact subcuticular cell layer.

The testes, 220–240 in number for each mature proglottis, are arranged in one layer in the whole medullary parenchyma in front of the ovary. The closely coiled vas deferens lies anteromedial to the proximal end of the cirrus pouch. The strongly convoluted ductus ejaculatorius and cirrus are beset with minute spines. The oval cirrus pouch, 0.3–0.4 mm long in mature or gravid segments, extends to near the median line of the proglottis. The protrusible cirrus opens directly behind the vagina into the genital atrium which in turn opens on one of the lateral margins about twice as far from the posterior end as from the anterior for several consecutive segments and then on the other for nearly an equal number of segments.

The dorsoventrally compressed X-shaped ovary lies at the posterior end of the proglottis, with its wings extending to near the lateral edges of the latter. The roundish compact shell gland and the coiled proximal end of the uterine duct lie immediately behind the ovarian isthmus. The uterine duct ascending dorsal and then ventral to the vagina opens into the ventral uterus at about the middle of the proglottis. The uterus, surrounded by numerous gland cells throughout its course, extends in the median line from the ovarian isthmus to the level of the proximal end of the cirrus pouch or a little more forwards; it is broadest near its anterior end and has a very sinuous wall. The subglobular, thin-shelled eggs, fixed in alcohol and measured in water, are 0.035-0.045 × 0.035-0.042 mm. The vagina opening directly in front of the cirrus passes inwards along the anterior border of the cirrus pouch, where it shows an elongated dilatation, and then descends in the median plane; it is surrounded by a coat of gland cells continuous with that of the uterus. There is a conspicuous receptaculum seminis vaginae. The acinous vitellaria extending along the entire lateral edges of the proglottis inside the inner longitudinal muscular bundles form a dorsal and a ventral layer, and enclose the lateral part of the testes; in cross section they are approximately U-shaped, interrupted at the base by the nerve trunk.

The ventral submedian excretory stem passes ventral to the cirrus pouch and vagina, close to the dorsal surface of the ventral wing of the ovary.

Discussion. This species is distinguished from all known members of *Phyllobothrium* by the conspicuous muscular thickening of the bothridial borders. In this respect it bears a superficial resemblance to *Orygmatobothrium* Diesing, but the character of the accessory suckers prevents it from being referred to this genus.

Phyllobothrium marginatum n. sp.

Specific Diagnosis. *Phyllobothrium* van Beneden, 1850, emend. Southwell, 1925. Strobila 60 × 0.8 mm or more, posteriorly constricted at segmentation line. Bothridia large, with thick muscular border. Four accessory suckers about 0.08 mm in diameter, at anterior end of bothridium. Neck long, slender. Gravid segments free, 2.5–3.2 × 0.87–1.1 mm. Inner longitudinal muscular bundles separated from each other by intervening subcuticular cells, not forming definite

sheath. Testes 220-240 in single layer. Ductus ejaculatorius spinose, strongly convoluted. Cirrus spinose, protrusible, opening directly behind vagina into genital atrium about twice as far from the posterior end as from the anterior. Genital pore on one side for some segments and then on the other. Cirrus pouch oval, extending to near median line. Ovarian wings extending to near lateral border of proglottis. Uterus extending a little more forwards than proximal end of cirrus pouch. Eggs subglobular, 0.035-0.045 × 0.035-0.042 mm. Vitellaria double-layered, lateral, just inside inner longitudinal mucles. Vagina dilated along anterior border of cirrus pouch. Receptaculum seminis vaginae present. Ventral excretory stem passing ventral to cirrus pouch and vagina, close to dorsal surface of ventral wing of ovary.

Habitat. Spiral intestine of *Squatina japonica*.

Locality and date. Toyama Bay; January 10, 1928.

Type and paratypes in my collection.

25. *Phyllobothrium prionacis* n. sp.

DESCRIPTION. This species was found in the spiral intestine of *Prionace glauca* (Linn.) from the Pacific. The largest mature, but not gravid specimen, the type, is about 12 mm long and has some fifteen segments, of which the last is 1.125 mm in length and 0.36 mm in maximum breadth at about the middle and terminates in a rounded point. The flat bothridia have thick crispate margins. The apical accessory sucker is about 0.11 mm in diameter. The slender neck is about 3.0 mm long. The mature proglottides with almost parallel sides are distinct, with the posterior borders only slightly overlapping the succeeding segment. The inner longitudinal muscle sheath is very poorly developed.

Fig. 84

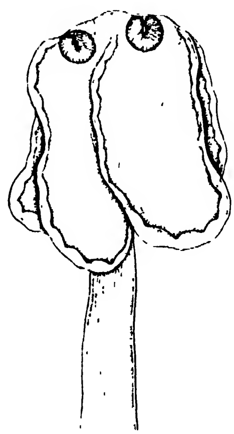

Fig. 85

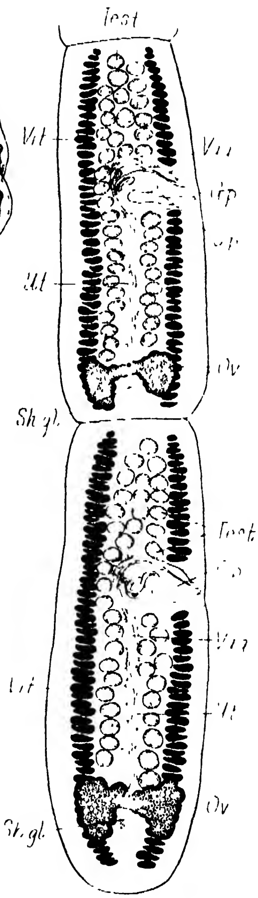

Fig. 84-85. *Phyllobothrium prionacis*.
Fig. 84. Scolex.
Fig. 85. Mature segments; ventral view. Type 0.09-1.1 × 0.35-0.36 mm.

The relatively large testes, 35-50 in number, lie in the lateral medulla in two longitudinal rows between the ovary and the cirrus pouch, in front of which they are also present in the median field. The pear-shaped cirrus pouch slightly crosses the median line, and contains a convoluted ductus ejaculatorius and a cirrus closely beset with minute spines and surrounded by numerous deeply staining cells. The genital atrium opens on the right or left margin of the proglottis a little in front of its middle.

The bilobed ovary, 0.16 × 0.25 mm, lies at the posterior end of the proglottis, with its compact, irregularly outlined wings bordered by the nerve trunks. The shell gland complex is confined to behind the ovarian isthmus. The uterus, not yet fully developed, extends forwards to near the proximal end of the cirrus pouch. The vagina curves round the proximal end of the cirrus pouch and forms a spindle-shaped dilatation before opening directly in front of the cirrus. There is no conspicuous receptaculum seminis. The vitelline follicles extend just inside the muscle sheath along the outer margins of the testes from the extreme anterior end of the proglottis to the ovary, some still further backwards.

The main excretory vessels run along the outer boundary of the testes, and the nerve trunks along that of the vitellaria.

DISCUSSION. This species is closely allied to *Anthobothrium parvum* mihi, but differs from it chiefly by the possession of accessory suckers and the position of the genital pore.

Phyllobothrium prionacis n. sp.

SPECIFIC DIAGNOSIS. *Phyllobothrium* van Beneden, 1850, emend. Southwell, 1925. Body length 12 mm or more. Bothridia flat, with crispate margins. Neck about 3.0 mm long. Proglottides about 15 in number; mature but not gravid segment 1.125 × 0.36 mm, with slightly projecting posterior borders. Testes 35–50, in two lateral groups. Cirrus pouch extending halfway across proglottis. Cirrus spinose. Ovary with compact lobes. Vagina opening directly in front of cirrus, with spindle-shaped dilatation near its opening. No conspicuous receptaculum seminis. Genital pores pre-equatorial, irregularly alternate. Vitelline follicles lateral to testes, occupying postovarian region in last mature segment.

Habitat. Spiral intestine of *Prionace glauca* (Linn.).

Locality and date. Pacific coast; March 24 (type date) and April 10, 1927.

Type and paratypes in my collection.

26. *Phyllobothrium dasybati* n. sp.

DESCRIPTION. A single mature specimen from the spiral intestine of *Dasybatus akajei* (Müller et Henle). It is 57 mm long by 0.9 mm broad and consists of some sixty segments. The bothridia are thin, with thick somewhat crispate margins. The small accessory suckers just in front of the bothridia are only 0.08 mm in diameter. There is a cupola-like myzorhynchus not projecting beyond the anterior ends of the bothridia. The slender, muscular neck, about 10 mm long, passes imperceptibly into the segmented portion. The mature posterior proglottides, about twice as long as broad, are distinctly constricted off from each other, the salient posterior borders appearing like a ring. The inner longitudinal muscles are fairly well developed even in mature proglottides. The excretory stems, a wide ventral and a narrow dorsal, lie along the inner edges of the vitellaria.

The testes, 250–350 for each mature proglottis, occupy all the available space of the medullary parenchyma, their lateral edges enclosed between the dorsal and the ventral layer of the vitellaria. The compactly coiled vas deferens

lies anteromedial to the proximal end of the cirrus pouch, which is oval, thin-walled, measures 0.32 × 0.2 mm and extends to near the median line when the cirrus is retracted but becomes much smaller when the cirrus is fully everted. The everted smooth cirrus is plump and flexible. The genital pores are unilateral and lies half as far from the anterior end as from the posterior.

The four-lobed ovary at the posterior end of the proglottis consists of slender, transverse lobules in the anterior part but of irregularly rounded acini in the posterior. The ventral median uterus terminates at the level of the cirrus pouch. The vagina opening directly in front of the cirrus shows in front of the cirrus pouch a spindle-shaped, transverse dilatation up to 0.09 mm wide,

Fig. 86

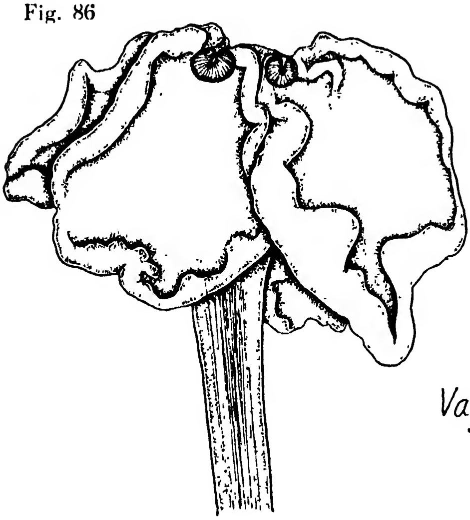

Fig. 87

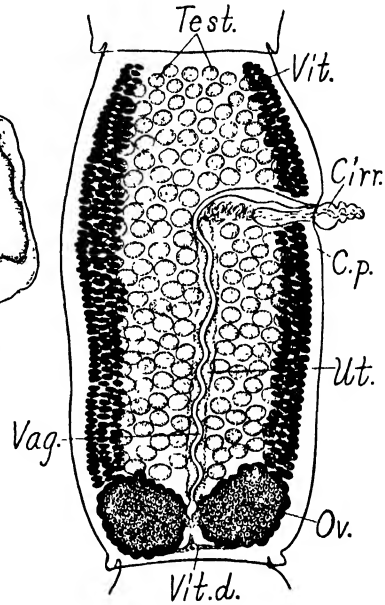

Fig. 86-87. *Phyllobothrium dasybati.*
Fig. 86. Scolex.
Fig. 87. Mature segment; dorsal view. Type 1.8 × 0.9 mm.

and curving round the coils of the vas deferens, descends in a slightly sinuous course. Before leading into the short seminal duct it forms a conspicuous receptaculum seminis up to 0.1 mm in diameter. The vitellaria, V-shaped in cross section, extend throughout the length of the proglottis just inside the muscle sheath between the lateral nerve cord and the excretory stems. The transverse vitelline ducts lie posteroventral to the ovary and unite with each other in the median line.

Discussion. This species may be identical with *Phyllobothrium thridax* van Ben., 1850, or with *P. unilaterale* Southwell, 1925, but these are too inadequately described to permit comparison. According to Southwell, the genital pores are situated in *P. thridax* slightly behind the middle of the lateral

margin in ripe segments but in the anterior half in a very gravid segment, and in *P. unilaterale* unilaterally in the anterior quarter. In my specimen which is mature but not gravid the unilateral genital pores lie constantly half as far from the anterior end as from the posterior.

Phyllobothrium dasybati n. sp.

SPECIFIC DIAGNOSIS. *Phyllobothrium* van Beneden, 1849. Body over 57×0.9 mm. Bothridia thin, with thick, somewhat crispate margins. Accessory suckers about 0.08 mm in diameter. Neck very long. Mature proglottides twice as long as broad or longer, constricted off from each other, with salient ring-like posterior borders. Genital pores unilateral, at junction of anterior with middle third of segment. Testes 250–350. Cirrus pouch thin-walled, voluminous when cirrus is retracted, but much smaller when cirrus is everted. Vagina opening directly in front of cirrus, spindle-shaped in front of cirrus pouch. Receptaculum seminis fairly conspicuous. Vitellaria well developed.

Habitat. Spiral intestine of *Dasybatus akajei* (Müller et Henle).

Locality and date. Pacific coast; August 9, 1926.

Type in my collection.

27. *Phyllobothrium* sp.

DESCRIPTION. Immature worms from the spiral intestine of *Isurus glaucus* (Müller et Henle). The largest entire specimen at my disposal is about 30m m in length and 1.1 mm in maximum breadth at about the junction of the anterior with the middle third of the body, whence it tapers gradually toward the pointed posterior extremity. The scolex, about 3.0 mm broad, bears four large pedicled bothridia with strongly crenulated margins. The terminal accessory suckers of the bothridia are 0.25 mm in diameter. The true neck region is apparnetly absent. The first proglottides are marked off by close transverse striations, but the posterior are distinctly segmented. The last sterile segment is approximately cone-shaped and measures 0.25×0.28 mm, while the penultimate one measures 0.4×0.5 mm. The lateral borders of each segment tend to become convex posteriorly. The strong circular muscular bundles underlying the cuticle are separated by regular intervals of 0.06 mm–0.12 mm, and the longitudinal fibers intrude into the subcuticular cell layer in the form of septa. The finely vacuolated, elongate subcuticular cells extend inwards more than one-third the thickness of the body. The inner longitudinal muscle sheath is lacking. In the dorsal cortex there is a very conspicuous median muscle band running throughout the strobila. The

Fig. 88

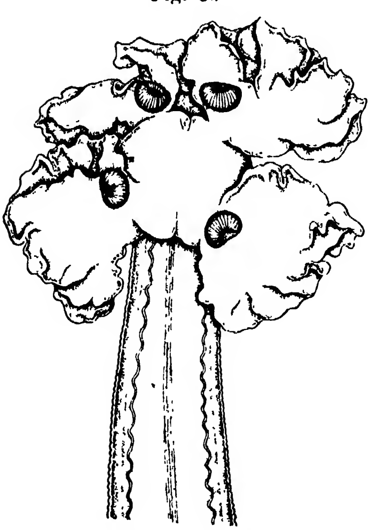

Fig. 88. Scolex of *Phyllobothrium* sp. from *Isurus glaucus*.

cellular medullary parenchyma is very thin in the anterior segments. The narrow dorsal and wide ventral excretory vessels run a sinuous course in the outer medullary parenchyma about one-fifth to one-seventh the breadth of the proglottis from the lateral margin. The nerve trunk passes along the lateral margin of the vitellarian anlage about 0.06 mm apart from the lateral edge of the proglottis.

The testes, whose number could not be made out, are closely arranged in the medulla in two lateral groups, bordered by the excretory trunks mentioned above. The elongate cirrus pouch extends to the median line, with its proximal end curved a little anteriad. The cirrus opens directly behind the vagina. The marginal genital pores lie a little in front of the middle of the proglottis, alternating irregularly from right to left. The vagina turns abruptly backwards at the proximal end of the cirrus pouch and forms the receptaculum seminis near the median posterior border of the proglottis. The female reproductive organs could not be clearly traced.

The specific determination of this worm is reserved until the adults are obtained.

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28. *Anthobothrium laciniatum* Linton, 1891

This species was found in the spiral intestine of *Scoliodon walbeehmi* (Bleeker) from the Pacific. The largest mature specimen comprising 106 segments is about 16 mm long; the last segment is 1.05 mm long by 0.77 mm broad, while one of the largest free segments is 3.7 × 1.2 mm. The scolex bears four stalked, trumpet-shaped bothridia with entire circular margins which appear more or less crumpled in accordance with the state of contraction. The base of the scolex, from which the bothridial stalks arise, is slightly constricted off from the first segment. The latter is 0.7 mm long and 0.11 mm broad at the posterior end which bears four tongue-shaped lappets 0.06 mm broad. As the segments are crowded toward the middle of the strobila, the dorsal and ventral lappets broaden accordingly, while the lateral ones show a conspicuous imbrication. In posterior proglottides, however, the lateral lappets are shorter and fused with the broad surficial ones with a median emargination which tends to become more conspicuous posteriorly.

The transversely elongated oval testes, 140–180 in number, occupy the entire available space of the medullary parenchyma. The coiled vas deferens is not conspicuous in whole mounts. The approximately pear-shaped cirrus pouch extends only slightly across the median line of the proglottis and contains a strongly convoluted ductus ejaculatorius at the base. The protrusible cirrus, closely beset with minute spines and surrounded by a dense cellular coat, opens directly behind the vagina on the lateral margin about half or one-third as

far from the anterior end as from the posterior.

The bilobed compact ovary with an irregular outline lies at the posterior end of the proglottis. The median uterus with a sinuous wall extends to the proximal end of the cirrus pouch, and in the free segment before me contains no eggs. The vagina opening in front of the cirrus passes inwards along the anterior border of the cirrus pouch and then backwards in the median plane, forming a conspicuous receptaculum seminis before joining the germiduct. The vitelline follicles are arranged in a dorsal and a ventral layer in the lateral fields of the medullary parenchyma just inside the poorly developed inner muscle sheath, with the outermost testicles between.

The main excretory stems run along the inner boundary of the vitellaria.

The above description conforms to that of Linton in essential particulars except in the cirrus which, according to him, appears to be smooth but is definitely spinose in my material. It seems very likely that he overlooked this armature.

Southwell (1925) referred this species to *Anthobothrium cornucopia* van Ben., 1850, but, as already pointed out by Linton, the two species are fundamentally different in size. In 1930 he included *Anthobothrium* in *Phyllobothrium* on the ground that the accessory suckers are often so difficult to make out that their presence or absence can not be made a differential generic character. I prefer, however, to retain the former genus.

It is to be noted that Linton found this worm later in the sharp-nosed shark (*Scoliodon terrae-novae*), generically same as the host of my specimens.

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29. *Anthobothrium parvum* n. sp.

DESCRIPTION. A number of this worm were found in the spiral intestine of *Alopias vulpinus* (Bonnaterre) from the Pacific. The type, fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam, is 4.85 mm long by 0.27 mm broad at about the middle of the last segment. The four, circular, almost sessile, membranous bothridia have slightly thickened, somewhat crispate borders. The slender unsegmented region is 2.0 mm long, with testicular anlagen in its posterior part. There are six proglottides with almost parallel sides, measuring respectively 0.13×0.14 mm, 0.14×0.16 mm, 0.21×0.17 mm, 0.4×0.21 mm, 0.63×0.24 mm and 1.1×0.26 mm; the posterior borders of mature proglottides overlap the succeeding segment only slightly. The well

developed inner longitudinal muscle fibers of the neck are continued into the basal parts of the bothridia.

The relatively large testicles, about 50 in number, extend irregularly in the medulla in two lateral groups from the anterior end of the proglottis to the ovary. The pear-shaped transverse cirrus pouch is longer than half the breadth of the segment. The convoluted ductus ejaculatorius and cirrus are closely beset with minute spines. The marginal cirrus opening together with that of the vagina lies almost thrice as far from the posterior end of the proglottis as from the anterior, irregularly on right or left.

The ovary, 0.21 mm long by 0.18 mm broad in the last segment, has longitudinally elongated lateral lobes, whose posterior ends are in direct contact with each other. The shell gland complex lies between the two lobes of the ovary. The median uterus with a zigzag outline reaches to the level of the cirrus pouch, but contains no eggs. The vagina passes toward the median line along the anterior border of the cirrus pouch, and opens directly in front of the cirrus. There is a small receptaculum seminis vaginae. The vitelline follicles extend along the lateral edges of the testes inside the poorly developed muscle sheath; in the last segment of a paratype with a pointed posterior end they intrude into the postovarian region.

The main excretory trunks pass between the vitellarian field and the testes.

Discussion. The above inadequate description shows that this species resembles *Anthobothrium lintoni* (Southwell, 1912) in the shape of the proglottides, but differs from it in the characters of the bothridia, the length of the strobila and neck, etc.

Anthobothrium parvum n. sp.

Specific Diagnosis. *Anthobothrium* van Beneden, 1850, emend. Southwell, 1925. Body 5.4×0.28 mm or more Bothridia almost sessile or with short stalk, membranous, with slightly thickened crispate margins. Neck very long. Proglottides about 6; first one or two slightly broader than long; last about four times as long as broad. Testes about 50 in number, in medulla in two lateral groups, without regular arrangement. Cirrus pouch pear-shaped, extending a little across median line. Cirrus and ductus ejaculatorius spinose. Ovarian lobes longitudinally elongate, with their posterior ends close together. Uterus not extending farther forward than cirrus pouch. Vagina opening directly in front

Fig. 89

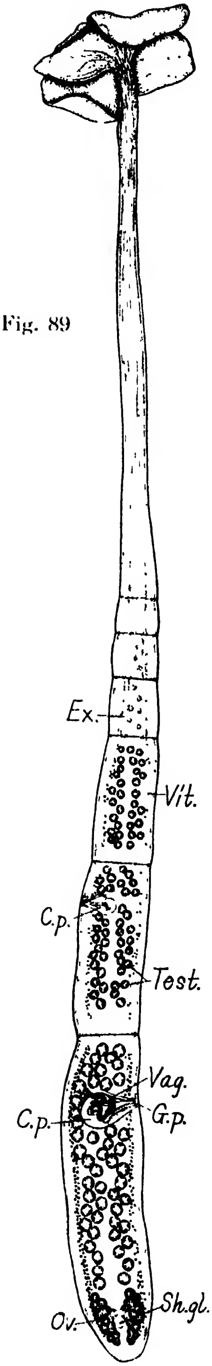

Fig. 89. *Anthobothrium parvum*; ventral view. Type 4.85 mm long.

of cirrus. Genital pore about thrice as far from posterior end of proglottis as from anterior, on right or left. Vitelline follicles lateral to testes, extending into postovarian region in last segment.

Habitat. Spiral intestine of *Alopias vulpinus* (Bonnaterre).

Locality and date. Pacific coast; March 26, 1927.

Type and paratypes in my collection.

30. *Orygmatobothrium plicatum* n. sp.

Description. One immature and two mature but not gravid specimens from the spiral intestine of a skate from Toyama Bay. The largest one is about 35 mm long and 0.9 mm broad near the posterior end. The swollen, dorsoventrally somewhat flattened scolex, bears four, equidistant bothridia, whose

Fig. 90

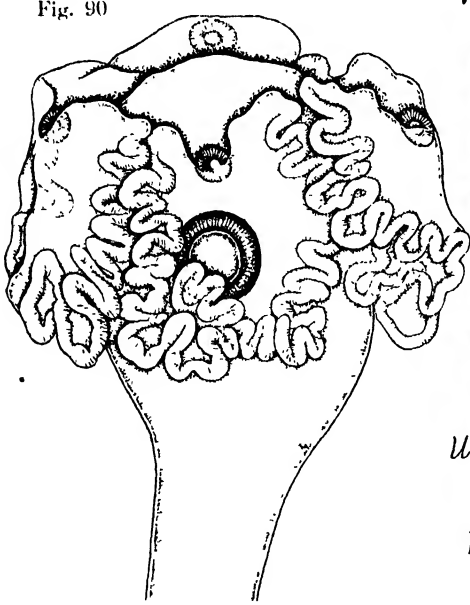

Fig. 91

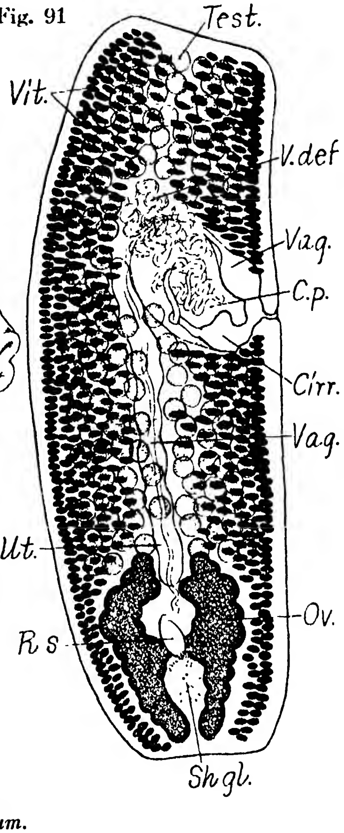

Fig. 90–91. *Orygmatobothrium plicatum.*
Fig. 90. Scolex.
Fig. 91. Mature segment; dorsal view. Type 2.1×0.75 mm.

strongly crenulated, thickened margins have short muscle fibers attached at right angles to the surface. The anterior accessory sucker, measuring about 0.15 mm transversely, lies at the front end of each bothridium, partly enclosed by the bothridial border. The posterior sucker at the middle of the bothridium is somewhat elongated longitudinally, about 0.23 mm broad and 0.05 mm thick.

The slender neck is about 13 mm long and 0.2 mm broad at the narrowest part some distance behind the scolex. The cuticle of the strobila, especially of the neck, are very finely serrated at the lateral margins. The lateral borders of the proglottides are slightly imbricated. The subcuticular longitudinal muscles are fairly well developed, without forming a definite layer. The strong inner longitudinal muscle sheath of the neck disappears in the posterior proglottides, but anteriorly is continued into the scolex in which it breaks up into bundles diverging toward the base of the bothridia and attached to them. In the scolex there are diagonal muscle fibers connecting the bothridia of opposite sides.

The paired dorsal and ventral excretory trunks lie near the median line in the neck region but more laterally in the proglottides in which they are separated from each other by the cirrus pouch and vagina. The nerve cord passes between the lateral edges of the dorsal and ventral layers of the vitellaria.

The testes, 130–160 in number, are closely massed in the medulla between the excretory stems of the two sides. The thin-walled, coiled vas deferens lies dorsal and a little anteromedial to the proximal end of the cirrus pouch. The relatively large cirrus pouch with a thin muscular wall extends obliquely to the median line, and contains a strongly convoluted ductus ejaculatorius and a wide cirrus lined by a thick cuticle and widely communicating with the expanded distal end of the vagina before opening into the genital atrium. The marginal genital pore lies in front of the middle of the proglottis.

The ovary lies at the posterior end of the proglottis and consists of a median isthmus and four lateral lobes arranged in dorsal and ventral pairs; it is broader than long in the anterior proglottides but longer than broad in the mature posterior proglottides, where it surrounds the shell gland nearly on all sides. The median, ventral uterus lies a little farther from the pore side than from the other, and its anterior end reaches to the level of the base of the cirrus pouch. The vagina has an enormous saccular swelling at the distal end immediately in front of the cirrus, which it joins by a wide aperture; it crosses the cirrus pouch on the dorsal side near its base, then descends in the median line dorsal to the uterus to form a fairly conspicuous receptaculum seminis on the dorsal side of the ovarial isthmus. The small, closely set vitelline follicles lie between the cortex and the medulla throughout the proglottis, only slightly interrupted in the dorsal and ventral median lines.

Discussion. A number of species have been referred to *Orygmatobothrium* Dies., 1863, but except the genotype they are all regarded by Southwell as doubtful or synonyms. My species undoubtedly belongs to this genus, but since the genotype, *O. versatile* Dies., is a larva, direct comparison with it is not possible, and my new species is therefore provisional.

Orygmatobothrium plicatum n. sp.

Specific Diagnosis.* *Orygmatobothrium* Dies., 1863. Length 35 mm or more. Bothridial

* Supplementing the inadequate generic diagnosis of Diesing.

borders strongly crenulated. Anterior accessory sucker 0.15 mm broad; middle one 0.23 mm broad. Neck very long, slender, strongly muscular. Proglottides slightly imbricated at lateral broders, without inner longitudinal muscle sheath; mature posterior ones about three times as long as broad. Excretory system consisting of a pair of wide, thin-walled ventral and narrow, thick-walled dorsal vessels almost in same parasagittal plane, but separated from each other by cirrus pouch and vagina. Nerve cord between lateral edges of dorsal and ventral layers of vitellaria. Testes 130-160, in medulla, between excretory stems of two sides. Cirrus pouch large, thin-walled, extending obliquely forward to median line. Coiled vas deferens dorsal and a little anteromedial to cirrus pouch. Ductus ejaculatorius strongly convoluted. Cirrus expanded distally, joining vagina before opening into genital atrium. Genital pores irregularly alternate, pre-equatorial. Ovary quadriradiate, longer than broad in mature posterior proglottides. Uterus opposite to pore side at its anterior end but median for greater posterior part and reaching to level of base of cirrus pouch. Vagina saccular at distal end, forming fairly conspicuous receptaculum seminis on dorsal side of ovarial isthmus. Vitellarian follicles small, closely massed between cortex and medulla, from end to end, only slightly interrupted in dorsal and ventral median lines.

Habitat. Spiral intestine of a skate.

Locality and date. Toyama Bay; Jan. 15, 1928.

Type and paratypes in my collection.

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31. *Echeneibothrium tobijei* n. sp.

DESCRIPTION. Four specimens were found in the spiral intestine of *Myliobatis tobijei* (Bleeker) from Toyama Bay. The type is over 8 cm long, linear and consists of more than 200 segments. The scolex has no myzorhynchus or rostellum. The deeply concave outer surface of each bothridium is divided by transverse septa into sixteen cup-shaped, strongly muscular loculi, of which the largest middle ones are 0.11 mm long by 0.074 mm thick at the base. The fan-shaped stalk of the bothridium contains strong, closely massed muscular bundles attached to the base of the loculi and continued into the inner longitudinal muscle sheath of the neck, with a wide sinuous excretory vessel in the center. The muscular neck, slightly constricted off from the segmented part, is 36 mm long and 0.25 mm broad at the beginning in the largest mature specimen, the type, while in the smallest immature one it is only 1.25 mm long and half as broad; it contains four axial excretory stems, two ventral and two dorsal. The anterior proglottides are broader than long but the posterior longer than broad, the isolated gravid ones measuring 2.16×1.18 mm. The imbrication of the lateral borders becomes conspicuous posteriorly.

The inner longitudinal muscular bundles tend to disappear in the posterior proglottides. There is no transverse musculature. The wide thin-walled ventral and the narrow thick-walled dorsal excretory vessels are separated from each other by the vagina and cirrus pouch. The nerve cord lies just inside the lateral edge of the muscle sheath along the outskirts of the vitellaria, dorsal to the cirrus pouch and vagina.

The testes, 140-160 in number, are in two groups between the excretory

Fig. 92

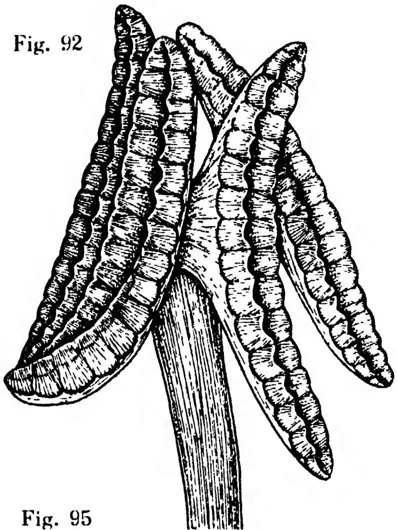

Fig. 93

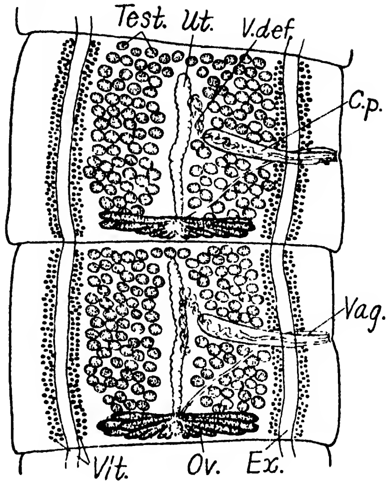

Fig. 95

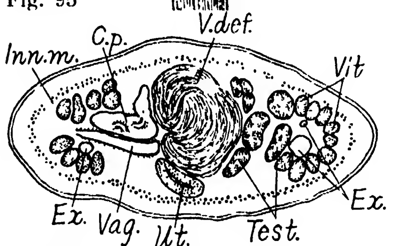

Fig. 94

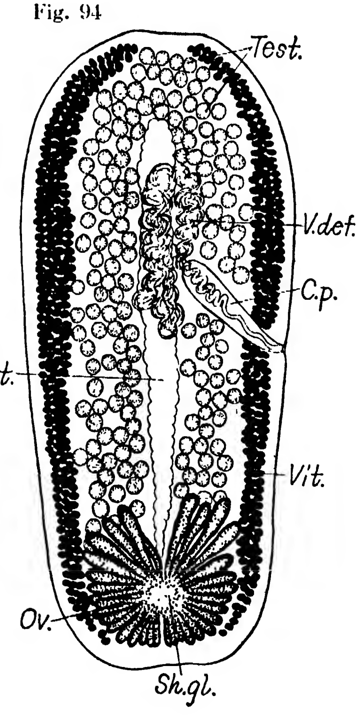

Fig. 96

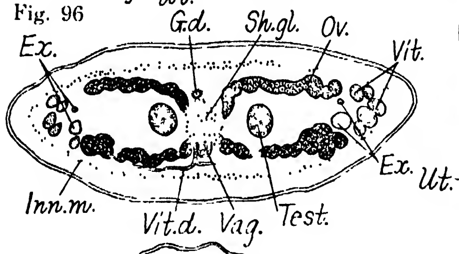

Fig. 97

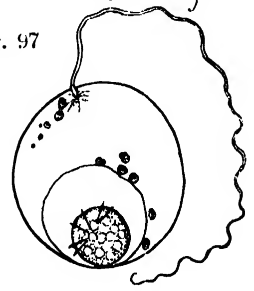

Fig. 92–97. *Echeneibothrium tobijei.* Fig. 92. Scolex. Fig. 93. Anterior segments; dorsal view. Fig. 94. Isolated gravid segment; dorsal view. 2.6×1.18 mm. Fig. 95–96. Transverse sections of maturing segment. Fig. 97. Filamented egg. $42\text{–}48 \times 36\text{–}42$ μ.

stems of the two sides but continuous across the median line at the anterior end of the proglottis, and extend into the space between the dorsal and ventral lobes of the ovary. The greater proximal part of the coiled vas deferens lies in the median line dorsal to the uterus; it begins at a level a little behind the genital pore and turns abruptly backwards about halfway between the proximal end of the cirrus pouch and the anterior end of the proglottis. The elongate, oblique cirrus pouch reaches to the median field. The proximal end of the cirrus and the ductus ejaculatorius are strongly convoluted. The cirrus opens on the right or left margin directly behind the vagina at about the middle of the proglottis.

The ovary, transversely elongated in most cases but almost circular in surface view in free gravid segments, lies at the posterior end of the proglottis; it is X-shaped in cross section and composed of numerous slender acini diverging from the median isthmus to the lateral excretory trunks; the shell gland appears to be enclosed in it. The opening of the uterine duct into the uterus proper could not be definitely located. The elongate median uterus reaches to near the anterior end of the proglottis. The subglobular, thin-shelled, non-operculate eggs are 0.0 12–0.048 × 0.036–0.042 mm and bear a flagelliform filament up to about 0.1 mm in length; the spherical onchospheres are about 0.016–0.018 mm in diameter and the hooks 0.008 mm long. The vagina crosses the cirrus pouch on its ventral side in the plane of the excretory stems. The vitellaria form two marginal bands in the medulla outside the testes between the excretory stems and the muscle sheath.

Discussion. Except for the arrangement and number of bothridial loculi, this species resembles *Echeneibothrium longicolle* (Linton, 1890) more closely than any other known members of the genus.

Echeneibothrium tobijei n. sp.

Specific Diagnosis. *Echeneibothrium* van Beneden, 1850. Strobila over 80 × 1.18 mm, consisting of more than 200 segments. Each bothridium with a single longitudinal row of 16 loculi. Neck up to 36 × 0.25 mm or more, strongly muscular, slightly constricted off from segmented region. Proglottides at first short, increasing in length uniformly; posterior borders overlapping succeeding segment. Gravid segments free, elongated, with slightly convex margins. Marginal genital pores irregularly alternate, almost equatorial. Testes 140–160. Cirrus pouch elongate, reaching to median field. Vagina opening directly in front of cirrus, crossing cirrus pouch on its ventral side in plane of excretory stems. Eggs 0.042–0.048 × 0.036–0.042 mm; filament up to 0.1 mm long; onchosphere 0.016-0.018 mm in diameter.

Habitat. Spiral intestine of *Myliobatis tobijei* (Bleeker).

Locality and date. Toyama Bay; January 16, 1928.

Type and paratypes in my collection.

32. *Echeneibothrium shipleyi* (Southwell, 1911)

This species was first reported by Southwell under the name of *Rhinebothrium shipleyi* but later identified by him with *Echeneibothrium minimum* van Ben., 1850. On the basis of my material from *Dasybatus akajei* which

corresponds largely to Southwell's original description, I hold that Southwell's species is unquestionably valid, the most important differences being found in the number of segments and the relative length and breadth of the last segments.

The following note is to supplement Southwell's description which referred only to external features and to justify my conclusion as to the specific identity.

The largest mature specimen at my disposal is about 20 mm long, but when gravid it may be much longer; it consists of about 130 segments, the last one measuring 0.94 × 0.67 mm. According to van Beneden, *E. minimum* consists of not more than 15 segments, the last segment being five or six times as long as broad. The bothridia and their loculi are just as described by Southwell. There is no myzorhynchus. Immediately behind the base of the bothridial stalks there is a short unsegmented portion. The mature segments with more or less convex sides are conspicuously imbricated at the posterior borders.

The inner longitudinal muscle sheath is fairly well developed.

Fig. 98

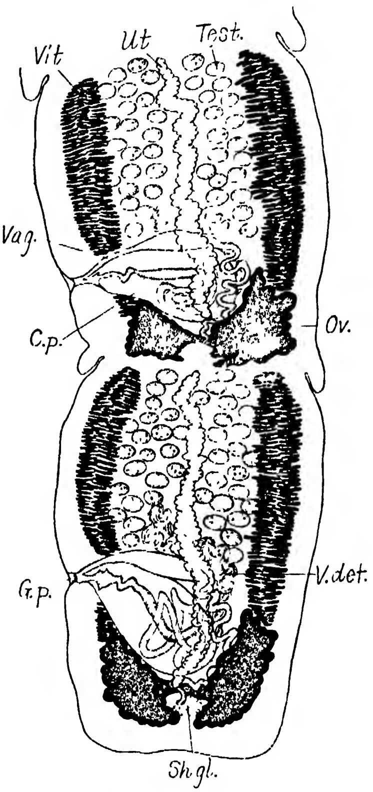

Fig. 98. Mature segments of *Echeneibothrium shipleyi* Southwell, 1911; dorsal view. Posterior segment 0.94 × 0.67 mm.

The relatively large testes, over 40 for each mature proglottis, are massed together between the median line and the lateral vitellarian fields, in front of the cirrus pouch and vagina. The vas deferens is coiled in the median line anterodorsal to the cirrus pouch. The voluminous, flask-shaped cirrus pouch, 0.4 × 0.24 mm in the proglottides represented in the figure and with a membranous wall, lies a little obliquely behind the middle of the proglottis, with its proximal end well past the median line. The ductus ejaculatorius and the cirrus, spinose throughout and almost inseparable from each other, are strongly convoluted. The distal part of the cirrus is wide, thick-walled and beset with larger spines, which are however absent from the very thin-walled portion opening into the genital cloaca. The genital pore is situated behind the middle of the proglottis, on right or left.

The ovary at the posterior end of the proglottis consists of a dorsal and a ventral pair of fairly compact lobes diverging widely in front to receive the proximal end of the cirrus pouch. The compact shell gland lies behind the ovarial isthmus between the posterior ends of the ovarial lobes. The uterus with sinuous walls extends in the ventral median line as far forwards as the

anterior end of the proglottis. The vagina opening directly in front of the cirrus consists of a spindle-shaped distal part lying transversely on the antero-ventral side of the cirrus pouch and of a strongly sinuous proximal part passing round the base of the cirrus pouch on its ventral side. There is a small receptaculum seminis. The transversely elongate vitelline lobules are very close together one behind another just inside the lateral part of the inner longitudinal muscle sheath, forming broad marginal strands interrupted by the cirrus pouch and vagina; in cross sections of a proglottis they form a V-shape on each side, with the excretory trunks and the lateral parts of the testes lying between the two arms which are dorsal and ventral.

Fig. 99

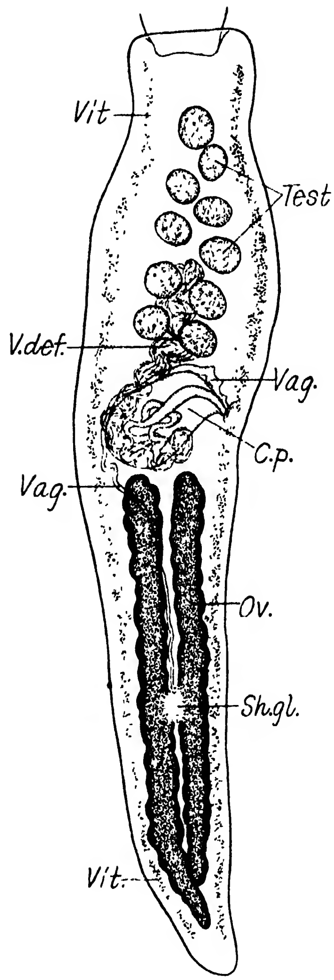

Fig. 99. Last segment of *Echeneibothrium flexile* (Linton, 1890); ventral view. 0.77×0.13 mm.

33. *Echeneibothrium flexile* (Linton, 1890)

A single young specimen of this species was found in the spiral intestine of ***Dasybatus akajei*** (Müller et Henle) from the Inland Sea in association with *E. shipleyi* (Southwell) described above. It is only 3.43 mm long and consists of sixteen segments, the last of which measures 0.77×0.13 mm. Each bothridium bears two longitudinal rows of about 40 loculi and is almost equally divided into a pedunculated anterior and a free posterior part; the latter may be flexed outwards or inwards at its articulation with the former. There is no myzorhynchus. The neck is short. The first eight segments are broader than long, the ninth is 0.085×0.075 mm and the succeeding ones increase rapidly in length. It is very interesting to note that in the approximately fusiform posterior segments the front end tends to be constricted off from the hinder part and receives the rather attenuated hind end of the preceding segment. This tendency is also indicated in Linton's original figure.

The relatively large testes, ten in number, are closely arranged in two longitudinal rows in front of the cirrus pouch, and were mistaken by Linton for eggs. The coiled vas deferens lies in the median field dorsal to the cirrus pouch and testes. The spinose cirrus is strongly convoluted in the extremely thin-walled cirrus pouch lying immediately in front of the ovary. The marginal opening of the wide genital atrium is in front of the middle of the proglottis.

The very long, symmetrical ovarial lobes, probably four in number as in other species of *Echeneibothrium* though not ascertained in cross sections, occupy almost the entire length of the posterior half of the proglottis. The extent of the uterus could not be made out. The vagina opening directly in front of the cirrus proceeds with conspicuous sinuosities toward the shell gland lying at about the middle of the ovary. The vitellaria form two marginal strands extending throughout the length of the proglottis.

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ONCOBOTHRIIDAE Braun, 1900

34. *Acanthobothrium cestraciontis* n. sp.

DESCRIPTION. This species was found in the spiral intestine of *Cestracion japonicus* (Duméril) from the Pacific. The largest specimen measures in alcohol 282 mm in length and consists of several hundred segments. The scolex has no accessory sucker. The bothridia are divided into three loculi. The thick muscular anterior border of each bothridium projects very prominently over the anterior loculus and is surmounted by a pair of bifid hooks 0.27–0.29 mm long, the inner prong with the basal tubercle being 0.16 mm long and the outer a little shorter. The anterior part of the neck is definitely broader than the remaining part which is only 0.5 mm broad. The exact length of the neck cannot be given, because the segmentation commences almost imperceptibly. The immature proglottides are broader than long with salient posterior borders, while the mature ones are definitely longer than broad and very fleshy.

The two muscular layers under the cuticle, an outer circular and an inner longitudinal, especially the latter, are well developed throughout the strobila. The subcuticular cells form a thick compact layer. The powerful inner longitudinal muscular bundles, attached to the anterior muscular edge of each bothridium, gradually decrease in strength and become separated from each other posteriorly, though the innermost bundles form a comparatively well defined layer; they disappear completely in the gravid proglottides. Neither the transverse nor the dorsoventral muscle is distinctly developed.

The testes, over 120 in number, fill up all the available space of the medullary parenchyma anterior to the ovary, some of them lying dorsal to the ovarial bridge. In the free gravid segments the testes are more or less markedly atrophied and situated dorsal to the uterus. The conspicuous mass of the coiled vas deferens extends obliquely forwards, with its proximal end in the median line. The pear-shaped, thin-walled cirrus pouch extends for about one-third the breadth of the proglottis. The narrow ductus ejaculatorius and the protrusible cirrus have a hair-like lining, except in the gravid segments.

Fig. 100

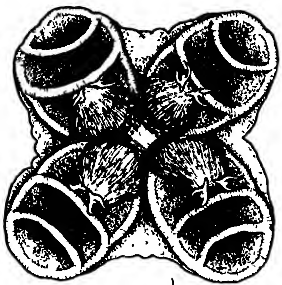

Fig. 101

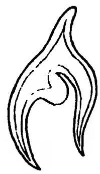

Fig. 104

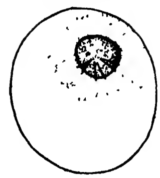

Fig. 102

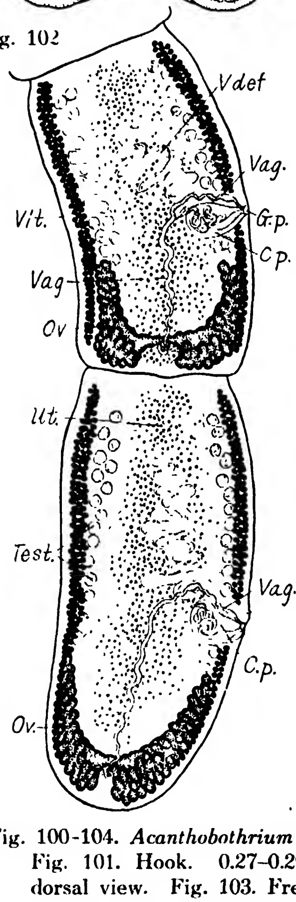

Fig. 103

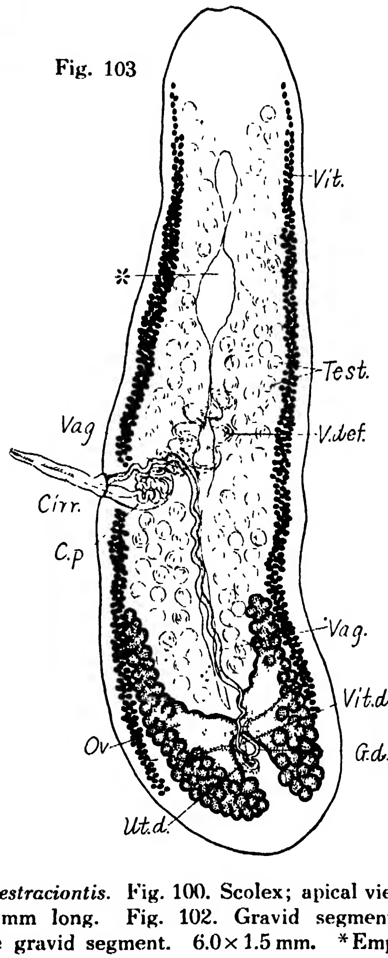

Fig. 100-104. *Acanthobothrium cestraciontis.* Fig. 100. Scolex; apical view. Fig. 101. Hook. 0.27–0.29 mm long. Fig. 102. Gravid segments; dorsal view. Fig. 103. Free gravid segment. 6.0×1.5 mm. *Empty uterus. Fig. 104. Egg. 66–84×60–78 μ.

The cirrus is spindle-shaped when retracted but may be as long as 0.58 mm when extruded, and has a light constriction near its base. The irregularly alternate genital pores lie behind the middle of each proglottis.

The two wings of the ovary at the posterior end of the proglottis are transversely oblong in immature proglottides but longitudinally elongated in gravid ones though not reaching to the cirrus pouch; they consist of numerous,

closely massed oval to globular acini. In some gravid segments the posterior ends of the ovarial wings are in contact. The germiduct arising from the oocapt at the isthmus of the ovary joins the vagina and then the common vitelline duct on the posterodorsal side of the isthmus, where the compact shell gland is situated. The ventromedian uterus arises as a solid cell mass but becomes hollow as it develops and is split up into compartments by ingrowths of the uterine wall; when fully gravid it discharges the eggs through a longitudinal ventral dehiscence reaching to near the anterior end of the testes. The subglobular, non-operculate, mature eggs measure 0.066–0.084 × 0.06–0.078 mm, with a very thin membranous shell; the subglobular onchospheres are 0.018–0.021 mm in diameter, with hooks 0.008 mm long. The vitelline follicles are in two longitudinal bands extending through the lateral edges of the medulla along the outer margins of the testes and ovary from the anterior end of the proglottis to near the posterior end of the ovary; they reach a little farther forwards than the testes, as shown in fig. 103. The transverse vitelline ducts pass ventral to the ovarial isthmus, at the middle of which they unite into a common duct proceeding backwards. The vagina opening directly in front of the cirrus forms a spindle-shaped dilatation anteroventral to the cirrus pouch and then passing dorsomedially leads into the narrow somewhat sinuous portion descending on the dorsal side of the uterus. There is no receptaculum seminis at the proximal end of the vagina.

Fig. 105

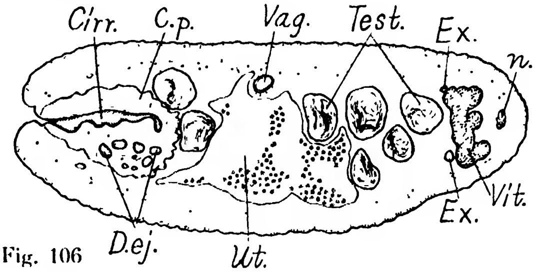

Fig. 106

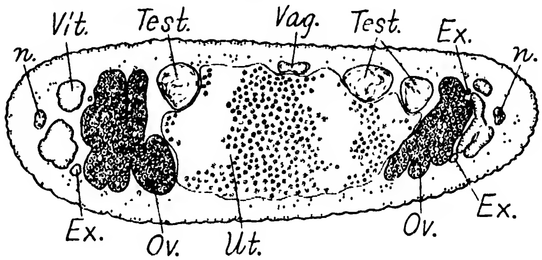

Fig. 107

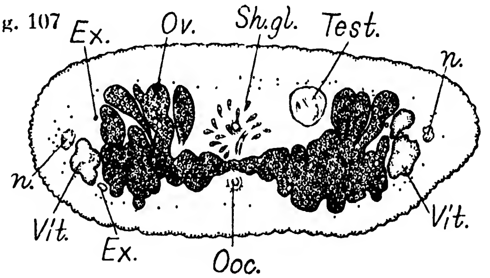

Fig. 105–107. *Acanthobothrium cestraciontis.* Transverse sections of gravid segment.

The narrow dorsal and wide ventral excretory stems lie between the vitellarian and the testiculo-ovarian fields. The nerve trunk lies immediately lateral to the vitellaria.

Discussion. According to Southwell's key to *Acanthobothrium*, the present species falls into the fourth category, undoubtedly between *A. macracanthum* Southwell, 1925, and *A. herdmani* Southwell, 1912, the most outstanding

difference being the absence of accessory suckers.

Acanthobothrium cestraciontis n. sp.

SPECIFIC DIAGNOSIS. *Acanthobothrium* van Beneden, 1850. Without accessory suckers. Strobila 28 cm long or longer, fleshy, with several hundred segments. Each bothridium with very muscular thickened anterior edge projecting prominently over anterior loculus, surmounted by bifid hooks 0.27–0.29 mm long, inner prong of which is 0.16 mm long and the outer slightly shorter. Testes over 120. Cirrus pouch extending for about one-third the proglottis breadth. Genital pore irregularly alternate, postequatorial. Ovarial wings elongated longitudinally in gravid proglottides, but not reaching to cirrus pouch. Mature eggs extremely thin-shelled, 0.066–0.084 × 0.06–0.078 mm; onchospheres subglobular, 0.018–0.021 mm in diameter.

Habitat. Spiral intestine of *Cestracion japonicus* (Duméril).

Locality and date. Pacific coast; April 9, 1927.

Type and paratypes in my collection.

35. *Acanthobothrium dasybati* n. sp.

DESCRIPTION. Four mature specimens were obtained from the spiral intestine of *Dasybatus akajei* (Müll. et Henle) at Tarumi. The type, which is largest but not yet gravid, is 52 mm long by 1.2 mm broad. The scolex is broader than long, measuring 0.68 × 0.87 mm, and bears no accessory sucker. The bothridium, 0.56 mm long, is divided into three loculi, of which the anterior, 0.31 × 0.25 mm, is the largest. The paired bifurcated hooks are about 0.13 mm

Fig. 110

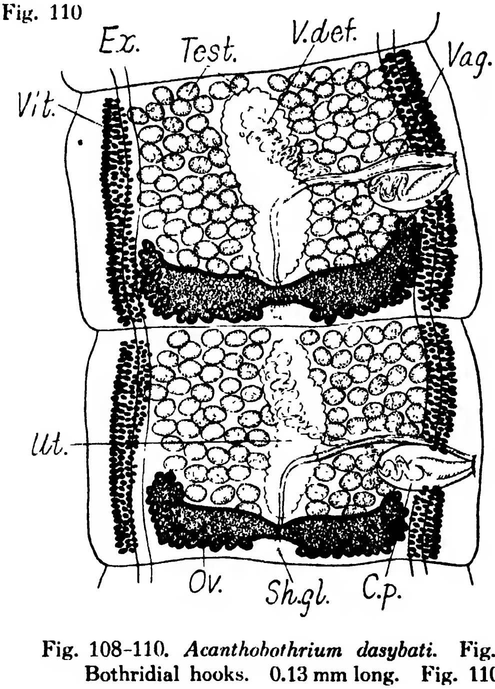

Fig. 108

Fig. 109

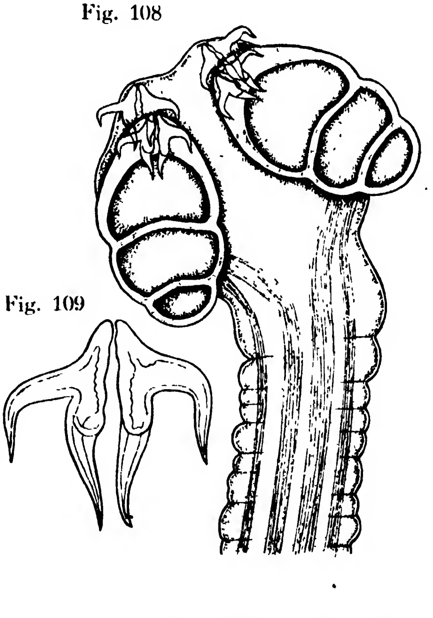

Fig. 108–110. *Acanthobothrium dasybati*. Fig. 108. Scolex. 0.68 × 0.87 mm. Fig. 109. Bothridial hooks. 0.13 mm long. Fig. 110. Mature segments; ventral view. 0.57–0.65 × 1.0 mm.

long; the outer prong, bent nearly at right angles, is 0.075–0.084 mm in length and almost as long as the inner. The slender neck, about 10 mm long and 0.37 mm in minimum breadth, is attenuated posteriorly and transversely wrinkled for a short distance behind the scolex. There are over 100 proglottides slightly constricted at the segmentation line. The strongly developed muscle sheath of the neck forms four powerful bands which are attached to the base of the hooks. The lateral nerve cord and the excretory stems lie on the ventral side of the cirrus pouch and vagina.

The testes, 90–110 in number, are closely arranged in the preovarian medulla between the excretory stems of the two sides. The coiled vas deferens curves from the proximal end of the cirrus pouch to near the anterior end of the uterus. The pear-shaped cirrus pouch contains a convoluted ductus ejaculatorius and a wide cirrus lined by a thick cuticle with fine hairs. The cirrus opens with the vagina on the ventrolateral margin at about the middle of the proglottis, with a certain tendency to be unilateral.

The bilobed ovary lies at the posterior end of the proglottis, with intensely stained lateral and posterior follicular lobules and very faintly stained transverse elongated medial lobes. The shell gland complex is posterodorsal to the ovarial isthmus. The wide median uterus with sinuous walls extends from the ovary to near the anterior border of the proglottis. The vitelline follicles lie on the inner side of the nerve cord and some of them extend medially to the excretory trunks. The vagina proceeds from its opening immediately in front of the cirrus inwards along the anterior border of the cirrus pouch and crosses the vas deferens on its ventral side between the median line and the cirrus pouch.

Discussion. This species resembles *Acanthobothrium cestraciontis* in the absence of accessory suckers, but differs distinctly in the shape and size of the hooks, in the characters of the strobila, etc. All other known species have accessory suckers and can be safely excluded from comparison.

Acanthobothrium dasybati n. sp.

Specific Diagnosis. Long-necked worm over 5 cm long and 1.2 mm broad. Scolex broader than long, 0.68 × 0.87 mm, without accessory suckers. Hooks 0.13 mm long, both prongs 0.075–0.084 mm long. Bothridia 0.56 × 0.25 mm. Proglottides over 100 in number, not imbricated. Inner longitudinal musculature well developed. Testes 90–110. Cirrus pouch extending medially for about one-fourth of proglottis breadth. Genital pores equatorial, irregularly alternate, but tending to lie unilaterally in posterior proglottides.

Habitat. Spiral intestine of *Dasybatus akajei.*

Locality and date. Inland Sea; September 12, 1927.

Type and paratypes in my collection.

36. *Ceratobothrium xanthocephalum* Monticelli, 1892

Description. A number of this worm were obtained from the spiral intestine of *Isurus glaucus* (Müller et Henle) at Kuki, Mie Prefecture. The largest specimen at my disposal is 25 mm long and has about 40 segments, the last one measuring 2.3 × 0.08 mm. The scolex, 0.92 mm long by 0.66 mm

broad, bears four muscular bothridia, each divided into an anterior loculus, 0.27 × 0.33 mm, and a posterior one, 0.75 × 0.45 mm. The horn-like appendages projecting at the posterolateral edges of each anterior loculus are about 0.05 mm long and consist mainly of circular muscle fibers. The neck, 0.87 mm long, is attenuated in the anterior half with a breadth of 0.2 mm. The proglottides, which are at first decidedly broader than long, are just as broad as long at about the twentieth segment, but the mature posterior ones are approximately barrel-shaped. The free gravid proglottides are elliptical or spindle-shaped, truncated anteriorly and bluntly pointed posteriorly.

The subcuticular longitudinal muscle fibers are greatly developed throughout the strobila, but especially in the neck region. They are continued into the scolex in four separate bands, which are each divided anteriorly into two short

Fig. 111

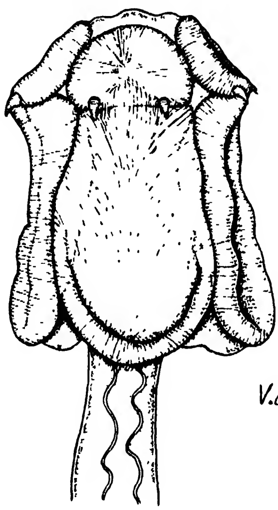

Fig. 112

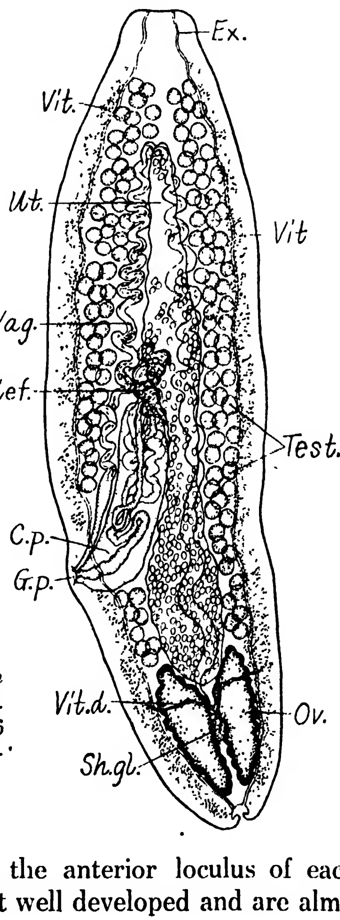

Fig. 111–112. *Ceratobothrium xanthocephalum* Montic., 1892. Fig. 111. Scolex. 0.92 × 0.66 mm. Fig. 112. Gravid segment; ventral view. 2.5 × 0.68 mm.

furciform branches and attached to the anterior loculus of each bothridium. The inner longitudinal muscles are not well developed and are almost completely absent from the mature proglottides.

The closely arranged testes occupy the entire submedian medulla in front of the ovary, except a small area at the anterior end of the proglottis; they

number a little over one hundred in an immature proglottis but 160–190 in a mature or gravid one. The elongate coils of the vas deferens lies along the median line on the pore side in front of the proximal end of the cirrus pouch, where the narrow, convoluted ductus ejaculatorius lies. The cirrus, closely beset with sharp spines about 6 μ long, opens directly behind the vagina into the genital atrium, which in turn opens on the lateral margin about half as far from the posterior end as from the anterior. The thin-walled cirrus pouch, 0.62 × 0.2 mm, extends obliquely to the middle of the proglottis or a little more forwards.

The ovary, 0.4 × 0.28 mm, consists of a middle isthmus and two finely acinous wings, the posterior ends of which approach each other to enclose the shell gland complex between them. The wide ventral uterus extending in the median line stops short of the anterior end of the testes. The light brown, thin-shelled eggs measure 0.021–0.027 × 0.018–0.021 mm in the mounted condition. The straight distal part of the vagina forms 0.25 mm from its opening a spindle-shaped expansion, the proximal end of which leads into the wide conspicuously twisted portion passing obliquely forwards as far as the anterior end of the uterus, where it turns backwards to descend along the uterus on its dorsal side. The vitelline follicles extend on the outer sides of the testes and ovary from a little in front of the anterior end of the testes to the posterior extremity of the proglottis. The transverse vitelline ducts unite ventral to the ovarial isthmus into a short median common duct. The main excretory vessels lie between the testiculo-ovarian and the vitellarian fields. The wide ventral excretory stems of the two sides empty into the vesicle, which opens outside at the median posterior notch of the last segment.

Aberrant Tetraphyllidea

37. *Pelichnibothrium speciosum* Monticelli, 1889

Description. A number of this peculiar tapeworm were found in the spiral intestine of *Prionace glauca* (Linn.) from the Pacific. The young worms have the larval tail still attached to them, but it is detached when about twenty proglottides are produced. The bothridia grouped in a dorsal and a ventral pair are 0.75–1.2 mm long by 0.5–0.9 mm broad, with more or less crispate borders, and attached to the scolex by a broad base. The accessory suckers, 0.22–0.3 mm in diameter, are situated directly in front of the anterior edge of the bothridia. The apical sucker on the haustellum is 0.15–0.21 mm in diameter. The segmentation begins at the broadest part of the body immediately behind the scolex, whence the body gradually narrows posteriorly. There is no unsegmented neck region. The anterior proglottides are considerably broader than long, but the maturing ones tend to be elongated, and as they are strongly constricted off from each other they assume an approximately oval outline. The free gravid segments are oval with a blunt anterior tip and measure up to 4.0 × 3.0 mm; they are more or less concave ventrally and convex dorsally,

with a prominent ventral elevation at the place of the uterus. The subcuticular longitudinal muscle fibers and the underlying cell layer are fairly well developed. The strong muscle fibers arising from the base of the bothridia and crossing over to the opposite side of the scolex extend into the proglottides to form a powerful inner sheath extending into the tail, but completely disappearing in mature proglottides.

The testes, over 200 in number, are closely arranged in the medulla in two broad submedian groups. The vas deferens is coiled longitudinally in front of the uterus a little more on the pore side. The elongate club-shaped cirrus pouch with a thin muscular wall is 0.3–0.4 mm long by 0.1 mm broad in mature

Fig. 114

Fig. 115

Fig. 116

Fig 113

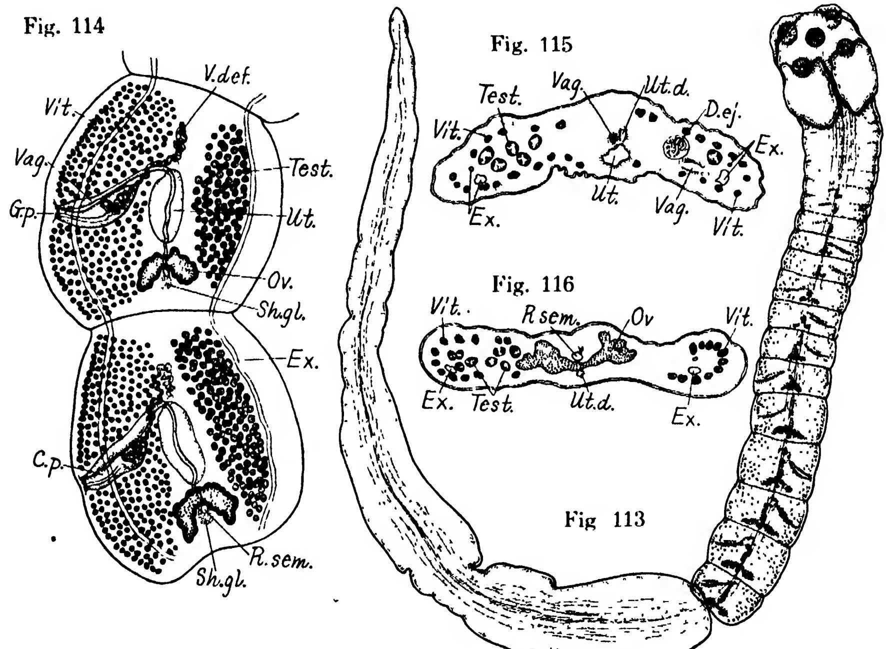

Fig. 113–116 *Pelichnibothrium speciosum* Montic., 1889. Fig. 113. Young worm. 22 mm long. Fig. 114. Mature segments; ventral view. 1.25 × 1.2–1.5 mm. Fig. 115–116. Transverse sections of mature segment.

proglottides measuring 1.2–1.3 × 1.2–1.5 mm; it is slightly curved, with the broad base directed anteromesad. The ductus ejaculatorius is convoluted at the base of the cirrus pouch. The cirrus, beset with exceedingly small spines and surrounded by numerous Begleitzellen, opens directly behind the vagina into the genital cloaca, which in turn opens widely on the right or left margin behind its middle.

The ovary at the posterior end of the proglottis consists of a median isthmus and two compact lobes of irregular outline; it is transversely oblong anteriorly but tends to be elongated longitudinally as it develops. The compact shell gland lies posterodorsal to the ovarial isthmus. The narrow uterine duct

proceeds forwards along the vagina dorsal to the uterus, into which it opens near the anterior end. The uterus is a longitudinally elongated elliptical, thin-walled sac about 0.37 mm long and surrounded by deeply staining cells; in a free gravid segment measuring 3.9×2.7 mm, it is of enormous size, 1.8×1.25 mm, and pushes the cirrus pouch and vagina toward the pore side, and the anterior parts of the ovarial lobes more widely apart from each other. The vagina proceeds from its opening directly in front of the cirrus obliquely forwards, forming a more or less pronounced fusiform swelling, and after crossing the vas deferens on its ventral side turns abruptly backwards at the anterior end of the uterus to lead into the narrow descending part, which passes dorsal to the uterus and forms an elongated receptaculum seminis antero-dorsal to the ovarial isthmus. The numerous small vitelline follicles extend from end to end in two broad lateral groups between the medulla and the cortex but leave the median field free. The eggs could not be examined in detail owing to poor preservation.

The narrow dorsal and wide ventral excretory vessels lie along the lateral edges of the testes just inside the vitellarian layer.

The tail continues its development after shedding and may attain a length of over 12 cm and a breadth of 3.0 mm. It consists of conspicuously gelatinous parenchyma and contains paired, very wide ventral and narrower dorsal excretory vessels, strong inner longitudinal muscular bundles, dorsoventral and transverse fibers. The most remarkable feature is the presence of a large dorsal median muscle band composed of numerous close bundles extending throughout the length of the tail. At the posterior end of the tail the ventral excretory stems open into the tubular vesicle at its apex; the narrow dorsal vessels of the two sides are united with each other dorsal to the anterior part of the vesicle. The nerve trunk lies just inside the lateral edge of the vitellaria. From the above description there is no doubt that the worm before me is identical with Monticelli's species, so far known only as larva.

Although *Pelichnibothrium* has been referred by Southwell to *Phyllobothrium*, it is readily distinguished from the latter by the characteristic disposition of the bothridia, the presence of an apical sucker and the tailed larva. In view of these characteristics the genus *Pelichnibothrium* should be isolated from other phyllobothriids as representing a distinct subfamily, Pelichnibothriinae, which I propose to define as follows.

Pelichnibothriinae n. subfam.

SUBFAMILY DIAGNOSIS. Phyllobothriidae Braun, 1900. Tail present even in final host until a certain degree of development is reached, and continuing to develop after shedding. Scolex with an apical sucker and four accessory suckers lying each directly in front of anterior border of bothridium. Four bothridia attached to scolex with broad base, in a dorsal and a ventral pair. Segmentation beginning immediately behind scolex. Proglottides strongly constricted off posteriorly, "euapolytisch." Inner longitudinal muscular bundles strongly developed in first segments and tail, but absent in mature ones. Tail with conspicuous median muscle band. Ventral excretory stems opening into tubular vesicle at posterior end of tail, where dorsal stems are continued into each other; both passing just inside vitellaria along outer edges of testes. Nerve

trunk just inside lateral edges of vitellaria. Testes very numerous, lateral, in medulla. Vas deferens coiled in front of uterus. Cirrus pouch elongate, thin-walled, oblique to longitudinal axis of body, opening directly behind vagina. Genital pores irregularly alternate. Ovary bilobed, compact. Uterine duct opening into uterus at its anterior end. Uterus longitudinally elongated elliptical, median. Receptaculum seminis present. Vitelline follicles numerous, lateral, between cortex and medulla, extending from end to end in mature segments, but absent from anterior tip in gravid ones. Parasitic in elasmobranchs. Larvae* in teleosts and cephalopods.

Type genus. *Pelichnibothrium* Monticelli, 1889.

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Zschokke, F. und Heitz, A. Entoparasiten aus Salmoniden von Kamtschatka. Rev. Suiss. Zool., Vol. 22, 1914, p. 205-217.

38. *Tylocephalum squatinae* n. sp.

DESCRIPTION. A single mature but not yet gravid specimen was found associated with *Phyllobothrium marginatum* mihi in the spiral intestine of *Squatina japonica* Bleeker from Toyama Bay. It is about 16 mm in length and 0.6 mm in maximum breadth near the posterior end. The subglobular myzorhynchus, 0.13 × 0.18 mm, has an apical fossa and is strongly constricted off by a narrow band from the basal disc (0.12 × 0.2 mm) having four suckers about 0.05 mm in diameter. The neck is about 0.6 mm long by 0.09 mm broad. The first segments are about five times as broad as long. In the immature middle proglottides the lateral margins overlap about half the length of the succeeding segment, but this lateral imbrication becomes less conspicuous in

Fig. 117

Fig. 118

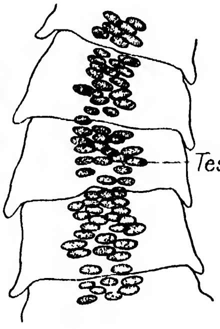

Fig. 119

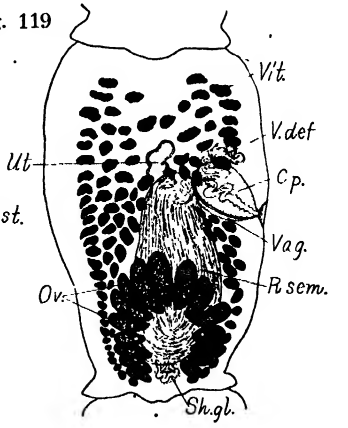

Fig. 117-119. *Tylocephalum squatinae.*
Fig. 117. Scolex. 0.2 mm broad.
Fig. 118. Immature segments, showing testes only.
Fig. 119. Mature segment; ventral view. Testes disappeared.

*Described on page 84.

mature, longitudinally elongated, posterior proglottides with convex, more or less posteriorly reflexed lateral margins. The strong inner longitudinal muscle fibers of the neck spread out fanwise in the myzorhynchus, but in mature proglottides they are poorly developed. The entire cortical parenchyma contains exceedingly numerous muscle fibers attached at right angles to the cuticle.

The testes, 40–50 in number, occupy the entire available median field between the main excretory trunks of the two sides. They tend to atrophy in mature segments and disappear when the receptaculum seminis is distended with spermatozoa. The closely coiled vas deferens lies directly in front of the cirrus pouch, at the base of which lies the convoluted ductus ejaculatorius. The wide cirrus opens with the vagina into the genital atrium which in turn opens at about the middle of the right or left margin by a conspicuously depressed aperture. The position of the genital pore varies more or less according to the state of contraction of the proglottis. The oval cirrus pouch with a thin muscular wall measures 0.13×0.08 mm, with its proximal end directed anteromesad.

The ovary consists of a number of radiating cylindrical lobules surrounding the posterior end of the receptaculum seminis; its dorsal lobules are smaller. The uterine duct arising from the shell gland posterodorsal to the ovary ascends in sinuous curves to empty into the uterus. The latter has a sinuous wall and extends a little farther forwards than the proximal end of the receptaculum seminis. The eggs were not observed. The vagina proceeds from its opening directly behind the cirrus inwards along the posterior border of the cirrus pouch and forms an enormous retort-shaped receptaculum seminis. The latter, 0.33×0.14 mm, extends in the median plane from the level of the proximal end of the cirrus pouch to the shell gland, where it gives rise to the short ductus seminalis at its posterior end. The relatively large, irregularly shaped vitelline follicles lie in the medullary parenchyma just inside the inner longitudinal muscle sheath, and extend from the anterior end of the proglottis to the posterior.

The main dorsal and ventral excretory trunks lie along the outskirts of the vitellaria.

Discussion. In Southwell's key to *Tylocephalum* species, this worm belongs to the fourth category represented by *T. yorkei* Southwell, 1925, and *T. dierama* Shipley et Hornell, 1906, but differs from them chiefly in the size of the strobila, in the shape of the ovary, etc.

Tylocephalum squatinae n. sp.

Specific Diagnosis. ***Tylocephalum*** **Linton, 1890. Strobila (not gravid) 16×0.6 mm, conspicuously imbricated. Myzorhynchus subglobular, 0.13×0.18 mm, with apical fossa. Basal disc 0.12×0.2 mm. Suckers 0.05 mm in diameter. Cortical parenchyma containing numerous muscular elements. Testes 40–50 in number, in medulla. Cirrus pouch oval, about one-third of proglottis breadth. Ovary composed of elongate acini surrounding posterior end of enormous receptaculum seminis. Vagina opening directly behind cirrus. Genital pores depressed, irregularly alternate, at or just behind middle of lateral margin. Vitellaria just inside inner longitudinal muscle sheath,**

extending entire length of proglottis.

Habitat. Spiral intestine of *Squatina japonica.*

Locality and date. Toyama Bay; January 10, 1928.

Type in my collection.

39. *Prosobothrium japonicum* n. sp.

DESCRIPTION. This species was found in the spiral intestine of *Prionace glauca* (Linn.) from the Pacific. The type, fixed in alcohol, stained with carmine and mounted in balsam, measures approximately 25 mm in length and 1.9 mm in maximum breadth at about the middle, whence it tapers gradually toward the anterior end, the posterior part being only slightly attenuated. The saucer-shaped scolex is 0.81 mm in diameter and sharply constricted off from the neck; it bears on its apical surface four sessile suckers delimited from each other by the ridges arising from its base and joining at the center. The shallow cup-shaped suckers, 0 25 mm in diameter, form a dorsal and a ventral pair, with their openings directed anteriad. The simple margin of the scolex and the septal ridges mentioned above are very closely covered with exceedingly small spines. The unsegmented neck, about 5.0 mm long and 0.5 mm broad in the constricted part behind the scolex, is armed except for a distance of about 0.55 mm behind the scolex with sharp, a little backwardly curved spines with a biramous root, which are more numerous though somewhat smaller posteriorly than anteriorly. The largest spines, 0.03 mm long, are found not at the very beginning but a little further behind. This armature is continued

Fig. 120

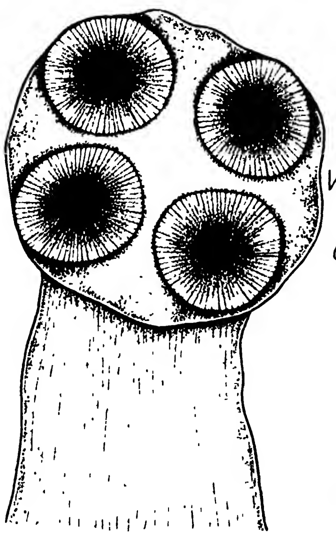

Fig. 121

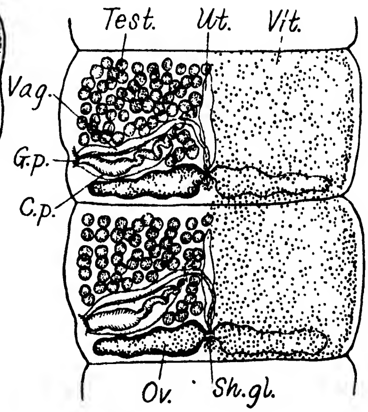

Fig. 120-121. *Prosobothrium japonicum.*

Fig. 120. Scolex; apical view. Type 0.81 mm in diameter.

Fig. 121. Maturing segments, ventral view. Testes and vitellaria shown unilaterally.

backwards with gradually decreasing density on to the mature proglottides. The proglottides which are at first considerably broader than long and not marked off externally, are more and more sharply separated from each other toward the posterior end of the strobila, where they tend to be more or less strongly constricted off. The last proglottis is approximately oval in outline and measures 1.08 × 1.1 mm, with a blunt anterior tip and a median posterior notch.

The cuticle contains a series of basophil granules which appear like the residue of the nuclei of the original epidermis. The subcuticular longitudinal muscle fibers arising from the scolex form instead of the inner longitudinal muscle sheath, especially in the neck, a powerful retractor of the body and scolex. In the neck region the subcuticular cell layer is a little farther removed from the cuticle than posteriorly.

The main excretory vessels, a narrow dorsal and a wide ventral, lie in the medulla from one-fourth to one-fifth the breadth of the proglottis from the lateral margin. The nerve trunk lies in the outer layer of the lateral medullary parenchyma.

The relatively large testes, 130–180 in number and arranged in two or three layers in the medulla, occupy the entire available space in front of the ovary. The coiled vas deferens is anteromedial to the cirrus pouch. The thin-walled cirrus pouch enclosing a closely coiled ductus ejaculatorius and a thickly spinose cirrus extends to near the median line, with its proximal end directed anteromesad. The cirrus opens directly behind the vagina. The irregularly alternate, marginal genital pores lie about twice as far from the anterior as from the posterior end of the proglottis.

The two ovarian lobes extend laterally along the posterior border of the proglottis to the vitellarian fields. The shell gland complex lies just behind the ovarial isthmus. The median tubular uterus reaches to near the anterior border of the proglottis and contains no egg even in the last mature segment. The oblique vagina lying in front of the cirrus pouch is slightly inflated and forms a small receptaculum seminis at its proximal end. The vitellaria lie between the cortex and the medulla, and surround the testes on all sides; some follicles extend past the lateral edges of the ovary to the posterior border of the proglottis.

Discussion. This species resembles *Prosobothrium armigerum* Cohn, 1902, but differs from it in the position of the coils of the vas deferens, in the number and arrangement of the testes, in the armature of the scolex, etc.

The present genus was placed by Southwell between Cyclophyllidea and Tetraphyllidea, but the character of the scolex and the general internal anatomy show it to be an aberrant phyllobothriid belonging to the latter order.

Prosobothrium japonicum n. sp.

Specific Diagnosis. *Prosobothrium* Cohn, 1902. Length up to 5.0 cm or more. Maximum breadth less than 2.0 mm. Scolex about 0.8 mm across, with exceedingly small spines on margin and ridges between suckers. Suckers 0.25 mm in diameter. Neck fairly long, covered except for

a short distance behind scolex with sharp, slightly curved spines, the largest of which is about 0.03 mm long. Proglottides also spinose, though less thickly; mature posterior ones more or less strongly constricted off. Testes 130–180, in two or three layers. Vas deferens coiled anteromedially to cirrus pouch. Cirrus densely spinose. Genital pores irregularly alternate, about twice as far from the anterior as from the posterior end of proglottis.

Habitat. Spiral intestine of *Prionace glauca* (Linn.).

Locality and date. Pacific coast; March 30, 1927.

Type and paratypes in my collection.

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40. *Discobothrium japonicum* n. sp.

Description. This species was found in the spiral intestine of *Narke japonica* at Kuki. The entire length of the worm could not be determined on account of its hyperapolytic nature. The scolex is very variable in shape and size according to the state of contraction. The terminal sucker of the myzorhynchus, 0.16 mm in diameter, is armed along its free border with exceedingly minute spines and can be withdrawn into the interbothridial space by the retractor muscles continued into the neck. When protruded it projects prominently over the bothridia on an attenuated peduncle. The four sucker-like bothridia, each with a short, stout peduncle and a longitudinally elongated oval opening, flare out conspicuously when extended, and measure 0.17–0.28 mm in longitudinal direction. The neck is only 0.12 mm long. The proglottides are very much broader than long anteriorly, but increase in length posteriorly; their posterior borders overlap the succeeding segments. The free gravid segments, 2.4–4.0 × 0.4–0.75 mm, are pointed posteriorly, and about the anterior fourth of each marked by a constriction is transformed into an elongate oval vesicle deeply stained at the anterior end. The subcuticular longitudinal muscles are well developed. The excretory system could not be worked out in detail.

The large roundish testes, only six in number, form a single median row in the preovarian field, the anteriormost projecting freely into the vesicle at the anterior end of the proglottis. There is no coiled vas deferens like that observed in other fish cestodes. The elongate, thin-walled cirrus pouch lies slightly obliquely on the posterodorsal side of the second testis; it contains a short ductus ejaculatorius and a narrow simple cirrus, the proximal end of which turns back on itself at the base of the cirrus pouch. The cirrus opens with the vagina on the ventral surface near the lateral margin at the level of the middle of the second fourth of the proglottis.

The ovary consists of six large follicular lobes, three on either side of the median line, lying in the third fourth of the proglottis. There is a distinct oocapt on the posterodorsal side of the ovarial isthmus. The germiduct arising

from the oocapt joins the narrow ductus seminalis just behind the oocapt and after describing a loop receives the common vitelline duct. The uterine duct forms two turns dorsal to the ovary and then ascends on the ventral side of the vagina to open into the uterus a short distance in front of the ovary. The elongate saccular uterus extends in the median line as far forwards as the vesicle mentioned above. The roundish, thin-shelled uterine eggs, 0.015–0.018 mm in diameter, have a delicate polar filament at each end, one about 0.07 mm or more long and the other 0.04 mm long. There appears to be no preformed uterine pore. The vitellaria consist of about thirty isolated follicles, some of which are arranged bilaterally in front of the ovary and the others behind it. Their anterior extent is variable according to individuals; in the largest specimen 3.96 mm long the anteriormost follicle lies at the level of the fourth testis. The postovarian follicles are bilaterally symmetrical just behind the ovary, but posteriorly they tend to lie somewhat irregularly. The vagina opening directly ventral to the cirrus is divided into three parts; the narrow distal part is only 0.3 mm long, the somewhat wider middle is sinuous and the proximal ductus seminalis is exceedingly narrow.

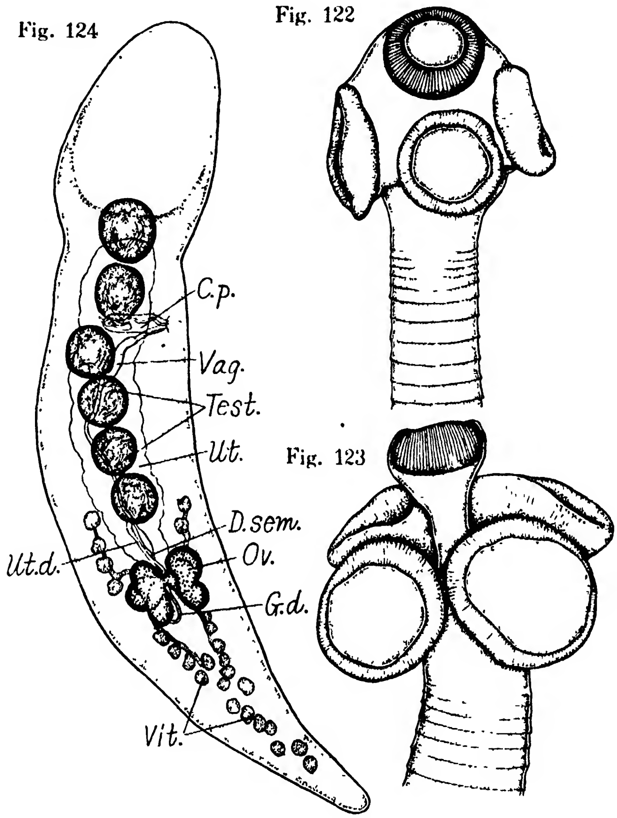

Fig. 122–124. *Discobothrium japonicum*. Fig. 122. Scolex, contracted. Fig. 123. Same, extended. Fig. 124. Free gravid segment; dorsal view. Type 2.44×0.44 mm.

Discussion. This species differs from *Discobothrium fallax* van Ben., 1870, in the position of the genital pore and testes, the characters of the cirrus and vas deferens, etc. It can be easily distinguished from *D. cobraeformis* (Shipley et Hornell, 1906) Southwell, 1925, by the shape of the strobila.

Discobothrium japonicum n. sp.

Specific Diagnosis. *Discobothrium* van Ben., 1870. Length unknown. Scolex mobile;

terminal sucker of myzorhynchus 0.16 mm in diameter when at rest; bothridia sucker-like, 0.17–0.28 mm longitudinally, with short peduncle and oval opening. Neck about 0.12 mm long. Strobila hyperapolytic. Posterior borders slightly imbricate. Free gravid segment pointed posteriorly, about anterior fourth marked off by a constriction. Testes six, in one median row; anteriormost one of gravid segment projecting freely into vesicular anterior portion. Cirrus pouch elongate, slightly oblique, pre-equatorial. Cirrus narrow, simple, opening with vagina on ventral surface near lateral margin at about middle of second fourth of proglottis. Ovary bipartite, three follicles on either side, in third fourth of proglottis. Uterus elongate saccular, reaching to anterior vesicle. Uterine eggs roundish, 0.015–0.018 mm in diameter, with a polar filament of unequal length at each end. Vitelline follicles about 30, bilaterally symmetrical, not reaching to cirrus pouch. Vagina opening directly ventral to cirrus, divided into three parts; proximal ductus seminalis very narrow.

Habitat. Spiral intestine of *Narke japonica*.

Locality and date. Pacific coast; April 11, 1927.

Type and paratypes in my collection.

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Tetraphyllidean Larvae

According to Southwell (p. 139), Zschokke included the larval forms of a number of species under the name *Scolex polymorphus* Rudolphi, while Monticelli expressed the opinion that this form develops into only one species, *Calliobothrium filicolle*. Curtis concludes from his experiments that *S. polymorphus* from the squeteague develops into *Phoreiobothrium triloculatum* in *Carcharias littoralis*. With Southwell and others, I believe that *S. polymorphus* represents the young of a number of different tetraphyllidean cestodes.

The *Scolex polymorphus* and other tetraphyllidean larvae are very common in Japanese bottom and pelagic fishes as well as in cephalopods, as listed below.

	Hosts	Locality	Date
I. *Scolex polymorphus* of monolocular type without accessory sucker	*Trichiurus japonicus*	Tomioka	Oct. 24, 1928
,,	*Engraulis japonica*	Toyama Bay	Jan. 24, 1928
,,	*Etrumeus micropus*	Inland Sea	Jan. 15, 1928
,,	*Stolephorus japonicus*	,,	July 26, 1928
,,	*Halichoeres poecilopterus*	,,	Aug. 30, 1929
,,	*Saurida argyrophanes*	Toyama Bay	Oct. 21, 1929
,,	*Upeneoides bensasi*	,,	,,
,,	*Pagrosomus unicolor*	Kuki	April 26, 1927
,,	*Hyporhymphus sajori*	Toyama Bay	Jan. 10, 1928
,,	*Muraenesox cinereus*	Inland Sea	Sept. 8, 1927
,,	*Sillago sihama*	,,	July 28, 1929
,,	*Parapercis pulchella*	Toyama Bay	June 19, 1928

	Hosts	Locality	Date
I. *Scolex polymorphus* of monolocular type without accessory sucker	*Callionymus valenciennesi*	Inland Sea	Aug. 15, 1928
"	*Rhinoplagusia japonica*	"	Sept. 7, 1929
"	*Tridentiger obscurus*	Toyama Bay	Oct. 27, 1929
II. *Scolex polymorphus* of monolocular type with accessory sucker	*Dasycottus setiger*	Toyama Bay	June 19, 1928
"	*Gadus macrocephalus*	"	Jan. 11, 1928
"	*Theragra chalcogramma*	"	"
"	*Chirocentrus dorab*	"	June 19, 1928
"	*Coryphaena hippurus*	"	Oct. 20, 1929
III. *Scolex polymorphus* of monolocular type with rostellum	*Etrumeus micropus*	Toyama Bay	Jan. 15, 1928
"	*Zeus faber*	Kuki	April 8, 1927
"	*Plectorhynchus cinctus*	Toyama Bay	Oct. 19, 1929
"	*Doederleinia berycoides*	"	"
"	*Trachurus trachurus*	"	Jan. 19, 1928
IV. *Scolex polymorphus* of bilocular type without accessory sucker	*Limanda angustirostris*	Toyama Bay	Jan. 12, 1928
"	*Argentina kagoshimae*	"	June 18, 1928
"	*Cypselurus agoo*	"	June 17, 1928
"	*Bothrocara zesta*	"	Jan. 22, 1928
"	*Furcimanus nakamurae*	"	June 18, 1928
"	*Dasycottus setiger*	"	Jan. 17, 1928
"	*Polypus vulgaris*	"	Jan. 19, 1928
"	*Ommatsrephes sloani pacificus*	"	Jan. 12, 1928
V. *Scolex polymorphus* of trilocular type with accessory sucker	*Pagrosomus unicolor*	Inland Sea	Aug. 9, 1928
"	*Sparus longispinis*	"	Aug. 2, 1928
"	*Spheroides pardalis*	"	Aug. 28, 1929
"	*Callionymus valenciennesi*	"	Aug. 20, 1930
"	"	"	Sept. 13, 1931
"	*Bothrocara zesta*	Toyama Bay	Jan. 14, 1928
"	*Cyclogaster owstoni*	"	June 21, 1928
"	*Parapercis pulchella*	Inland Sea	May 18, 1931
VI. *Echeneibothrium* larvae	*Histiophorus orientalis*	Toyama Bay	Oct. 20, 1929
"	*Muraenesox cinereus*	Inland Sea	July 18, 1928
"	*Conger myriaster*	Kuki	April 1, 1927
"	*Fistularia petimba*	Toyama Bay	Jan. 19, 1928
"	Gobiids	Inland Sea	April 1, 1928
		Ise Bay	April 19, 1929
		Toyama Bay	Oct. 27, 1929

	Hosts	Locality	Date
VI. *Echeneibothrium* larvae	*Limanda angustirostris*	„	Jan. 14, 1928
„	*Rhinoplagusia japonica*	Toyama Bay	Oct. 21, 1929
„	*Uranoscopus japonicus*	„	Oct. 23, 1929
„	*Lotella physis*	„	Oct. 20, 1929
VII. *Pelichnibothrium* larvae	*Salmo keta*	?	Sept. 10, 1932
„	*S. milktschitsch*	Mutu Bay	Aug. 11, 1927
„	*Loligo* sp.	Toyama Bay	June 19, 1928
„	*Spheroides spadiceus*	„	Jan. 11, 1928
„	*Euthynnus pelamys*	„	Jan. 19, 1928

I. *Scolex polymorphus* of Monolocular Type without Accessory Sucker

The monolocular *Scolex polymorphus* measures 0.64–2.0 × 0.11–0.35 mm, the smallest ever met with being only 0.27 × 0.06 mm. The apical sucker is 0.033–0.11 mm in diameter. The monolocular bothridia are usually a little longer than broad and measure 0.033–0.16 × 0.03–0.13 mm. This worm occurs mostly in the small intestine or pyloric appendages and rarely in the gall bladder. It has also been found in the ovary of *Trichiurus japonicus* and in *Diagenes edwardsii* (de Haan). The specimen from the latter host is only 0.46 mm long; the apical sucker is 0.045 × 0.06 mm and the bothridia are about 0.06 mm in diameter. It is probably identical with the worm found by van Beneden in *Carcinus* and *Eupagurus*.

II. *Scolex polymorphus* of Monolocular Type with Accessory Sucker

The early stages of *Pelichnibothrium* are excluded from this group. The body is 0.9–6.0 × 0.2–0.8 mm. The apical sucker is 0.05–0.11 mm in diameter. The accessory sucker, 0.06–0.13 × 0.08–0.16 mm, lies directly in front of the bothridium, partly surrounded by the anterior border of the latter. The bothridia have thick, more or less muscular borders and measure 0.1–0.4 mm in length. There is no partition marking off the tail region.

III. *Scolex polymorphus* of Monolocular Type with Rostellum instead of Sucker.

This worm is distinguished from that of the first category by the presence of a muscular rostellum in place of the cup-shaped apical sucker. The rostellum is somewhat depressed in front and funnel-shaped in outline, measuring 0.12–0.26 × 0.075–0.23 mm; its posterior end may extend farther backwards than the posterior ends of the bothridia. The arrangement of the muscle fibers is shown in the figure. In a specimen from *Muraenesox cinereus* the rostellum is disc-shaped and measure 0.06 × 0.2 mm. There is no accessory sucker. The oval bothridia are 0.075–0.16 × 0.036–0.13 mm. It is worth noting that the larvae of this group have been found in pelagic fishes only, indicating that the adults must be looked for in sharks and not in skates.

Fig. 125

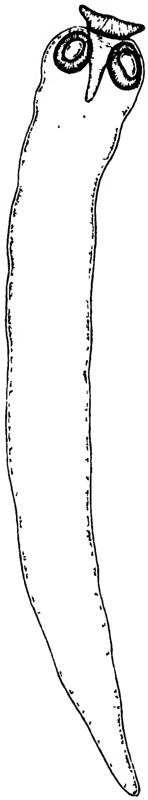

Fig. 125. *Scolex polymorphus* with funnel-shaped rostellum from *Zeus faber* Linn. 2.6 mm long.

IV. *Scolex polymorphus* of Bilocular Type without Accessory Sucker.

This group is characterized by the absence of a typical accessory sucker and by each bothridium being occupied by a large bilocular sucker measuring 0.12–0.26 × 0.08–0.2 mm. The body ranges from 0.8 to 2.2 mm in length and from 0.2 to 0.52 mm in breadth. The apical sucker is 0.04–0.18 mm in diameter.

V. *Scolex polymorphus* of Trilocular Type with Accessory Sucker

The body is definitely larger than the worms already described, measuring 1.8–7.5 × 0.18–0.55 mm. The apical sucker is 0.04–0.09 mm in diameter and the accessory sucker 0.036–0.12 mm in diameter. The bothridia, 0.25–0.38 × 0.11–0.2 mm, are divided transversely into three loculi, of which the anteriormost is the largest. There are red pigment patches immediately behind the scolex.

Although the hooks are not yet developed, the larvae undoubtedly belong to *Acanthobothrium* or *Calliobothrium* or *Oncobothrium*.

In *Callionymus valenciennesi* I found a larva whose anterior septum of the bothridia is raised at the middle in the form of a cone or papilla. The apical sucker and the bothridia are very much larger than those of the usual type, the former measuring 0.12–0.23 mm in diameter and the latter 0.45–0.57 × 0.34–0.36 mm, while the accessory sucker is relatively small and 0.08 mm in diameter.

VI. *Echeneibothrium* Larvae

Although there seems to be a number of different species, their identification is almost impossible, because the bothridia which provide the most important clue to specific determination are in the majority of specimens entirely retracted into the body. In only two cases could the number of bothridial loculi be counted with certainty, i. e., the larvae from *Rhinoplagusia japonica* and *Fistularia petimba*. In the former the body is 1.1 mm long by 0.25 mm broad, with the apical sucker measuring 0.13 × 0.15 mm, and the four bothridia, each with a single row of sixteen loculi, are all retracted into the body, while in the latter, in which the posterior half of the body is invaginated into the

anterior half, the apical sucker is 0.13×0.16 mm, and two of the bothridia, each with sixteen loculi, project very prominently. Both are evidently larvae of *Echeneibothrium tobijei*. The larvae from *Lotella physis* and *Uranoscopus japonicus* have over 50 loculi arranged in two longitudinal rows in each bothridium; their specific identification is reserved for later study.

VII. *Pelichnibothrium* Larvae

The specimens from *Loligo* sp. vary from 7.5 to 23 mm in length and from 0.56 to 1.3 mm in breadth. The apical sucker measures $0.11\text{–}0.18 \times 0.12\text{–}0.23$ mm and the accessory sucker 0.15–0.31 mm in diameter. The bothridia have more or less crumpled margins. The tail is a little longer than the body proper, whose posterior part is apparently segmented.

The worms from *Salmo keta* are 15.5 mm long and 0.75 mm broad behind the scolex; the apical sucker is 0.16×0.2 mm and the accessory sucker 0.28×0.33 mm; the bothridial borders are crispate; the tail is a little shorter than the body proper which shows a distinct segmentation at the posterior end. The well developed subcuticular longitudinal muscles form powerful median bands, of which the dorsal one is the larger. In the median field of the medullary parenchyma there are also a number of strong longitudinal bundles which give the worm a conspicuous striation parallel to the median band. The dorsal and ventral excretory stems lie close together in each lateral half of the body and are directly continued into the scolex, in which they pursue a very characteristic course (fig. 126).

Fig. 126

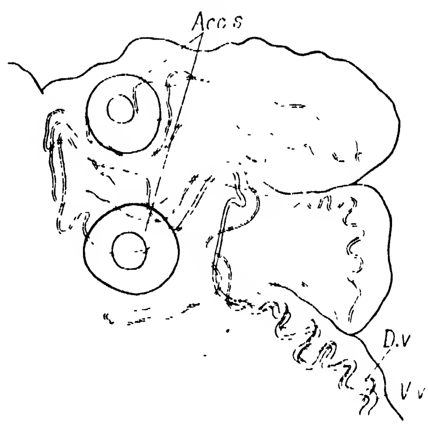

Fig. 126. Scolex of *Pelichnibothrium speciosum* Montic., 1889, showing excretory system.

Whether these two forms are specifically distinct from each other, I cannot determine, but as only one species of *Pelichnibothrium* is so far known, I prefer to regard the two as the larva of *P. speciosum* Monticelli, 1889. *Pelichnibothrium caudatum* Zschokke et Heitz, 1914, and *Phyllobothrium salmonis* Fujita, 1922, undoubtedly correspond to the second form just described; so I regard them for the present as the larvae of Monticelli's species.

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DIBOTHRIORHYNCHIDAE Ariola, 1899

41. *Dibothriorhynchus squali* (La Martinière, 1797)

Syn. *Tetrarhynchus megacephalus* Rud., 1819
T. grossus Rud., 1819
T. attenuatus Rud., 1819

This species, figured by La Martinière under the name of *Hirudo squali* and described by Bosc as *Hepatoxylon squali*, was found firmly attached to the stomach wall of *Isurus glaucus* (Müller et Henle) on October 18, 1926, at Kuki and its larval form on March 31, 1927, in the body cavity and on the serous membrane of the stomach and liver of *Prionace glauca* (Linn.) from the same locality. Although the external features of the worm have been dealt with by various authors, the detailed anatomy of the adult still remains to be studied.

The largest specimen at my disposal is about 10.0 cm long by 1.0 cm broad. In fully developed individuals the scolex, 8.0 mm long, 7.0 mm broad and 3.0 mm thick, is irregularly corrugated all over except the bothridia, and sharply demarcated from the strobila by its prominent posterior border, while in smaller ones it is marked off by a slight constriction. The taeniaeform strobila bears on both surfaces one or two submedian longitudinal furrows on its fleshy imbricated posterior borders. The gravid posterior segments are dark greyish and have a double uterine pore on the ventral surface, each about one-fifth the proglottis breadth from the lateral margin. The last segments, usually narrower than the others, very often show forking or casual dehiscence.

The subglobular or short cylindrical proboscis, 1.15–1.25 × 0.72–0.75 mm, bears large numbers of stout, strongly recurved, hollow hooks arranged in close spirals and gradually decreasing in size posteriorly. The largest hooks at the apex measure about 0.26 × 0.225 mm, while the smallest at the base are only 0.03 mm long. The inverted portion of the proboscis, also beset with hooks becoming smaller posteriorly, has a thick coat of musculo-fibrous tissue which passes over the inner surface of the proboscis at the apex, but becomes more and more thin toward the unarmed posterior end where the muscular bundles are attached to the cuticle and continued farther backwards as proboscis retractor. There are two slender ligaments arising each with a broad base from the dorsal and the ventral inner surface of the anterior part of each proboscis sheath and attached to the corresponding parts of the proboscis.

The inner cavity of the proboscis contains amorphous coagulum in alcoholic specimens. The retractor is attached to the inner wall of the proboscis sheath at its posterior end on the outer side. The muscular bulb composed of in-

Fig. 128

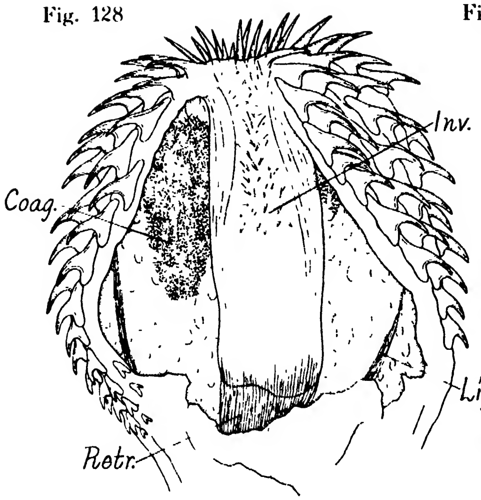

Fig. 127

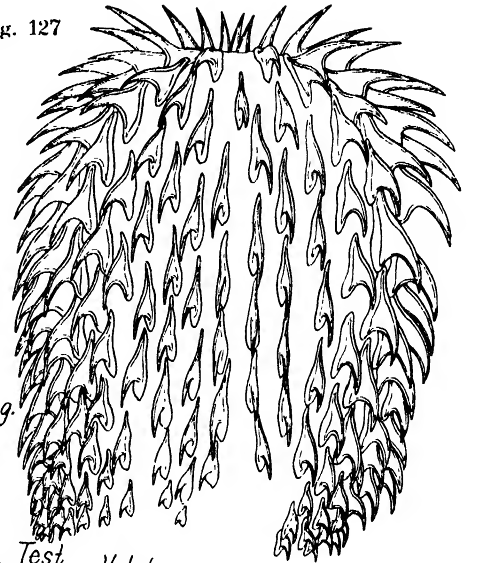

Fig. 130

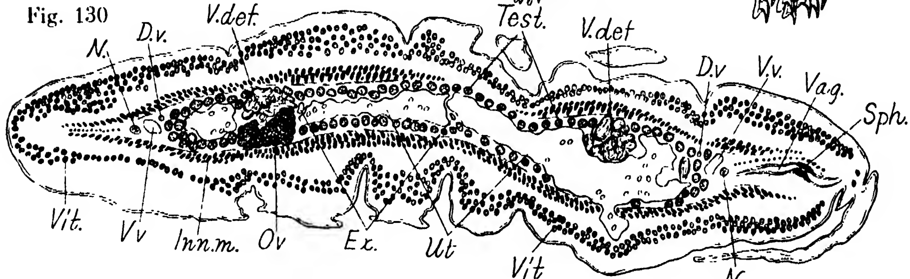

Fig. 129

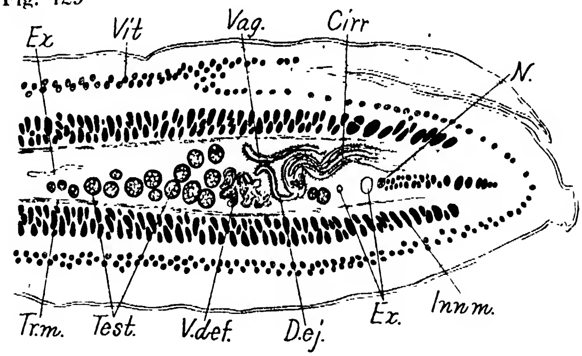

Fig. 127–130. *Dibothriorhynchus squali* (La Martinière, 1797).
Fig. 127. Proboscis.
Fig. 128. Same, teased open to show inverted portion of proboscis, ligaments, retractor, etc.
Fig. 129. Transverse section of young proglottis.
Fig. 130. Transverse section of gravid proglottis.

numerable thin lamellae extends farther backwards than the posterior end of the bothridia.

The elongate bothridia are very prominent in the larvae, but become less prominent in adults owing to the excessive development of the lateral edges of the scolex, where the strong muscular bundles radiate toward the puckered free margins; each bothridium is divided by a median septum which bifurcates at about its middle into small ridges. From their weak musculature and the

fact that the worm is attached to the stomach wall of the host only by means of the proboscides, it may be inferred that the bothridia are not very efficient suctorial apparatuses.

The large cephalic ganglion lies directly lateral to the excretory trunk at the level of the posterior end of the proboscis sheaths; it gives rise to an anterior and a posterior stem, the latter running along the main lateral excretory vessel dorsal to the cirrus and vagina.

The excretory system of the scolex consists of a pair of very wide vessels passing between the proboscis sheath and the nerve trunk mentioned above; anteriorly it splits up into a plexus lying for the most part in the superficial portion of the lateral borders of the scolex. In the proglottides there are a wide thin-walled and a narrow thick-walled stems along the lateral edge of the medulla directly medial to the nerve trunk and dorsal to the cirrus and vagina, the latter being medial or dorsomedial to the former. There are also smaller vessels between the stems of the two sides, all connected by more or less broad transverse commissures.

In the anterior proglottides, the inner longitudinal muscles form a very powerful sheath as thick as the medulla, but tend to become weaker posteriorly; they are separated at their lateral edges by the lateral extension of the underlying transverse muscle layer into three layers, the middle one having the form of an elongate wedge with the broad base reaching to the nerve trunk.

The testes lie close together in the medulla between the wide lateral excretory stems. The long, protrusible cirrus lined by a thick cuticle, opens with the vagina near the anterior end of the lateral margin of the proglottis; it is enclosed in the long, somewhat sinuous receptaculum cirri extending transversely along the anterior border of the proglottis to near the uterus. The sinuous ductus ejaculatorius lined by a ciliated epithelium projects in the form of a small papilla into the somewhat expanded, ciliated base of the cirrus receptacle, and is sometimes greatly distended into a vesicula seminalis. The compact mass of the coiled, thin-walled vas deferens lies near the dorsal transverse muscle layer.

The ovary lies in the ventral medulla on either side of the median plane; it consists of a middle isthmus and two symmetrical compact lobes with an irregular outline. The compact shell gland lies posterodorsal to the ovarial isthmus. The vagina with a conspicuous sphincter at its aperture directly behind the cirrus, passes medially along the receptaculum cirri and crossing it comes to the ventral part of the medulla, and after an abrupt turn immediately in front of and ventral to the ovarial isthmus forms a large elongate receptaculum seminis filled with spermatozoa. The ductus seminalis is short. The convoluted uterine duct passes lateral to the ovary and opens into the spacious uterus. The latter extends transversely over the vas deferens and ovary between the lateral excretory stem and the median plane, and is separated from its fellow of the other side by the median septum of variable breadth according to the degree of development of the uterus. When excessively developed the uteri of the two sides probably unite with each other in the median line at

the expense of the septum. The paired ventral uterine pores lie each about one-fifth the proglottis breadth from the lateral margin. The oval, light brown, non-operculate eggs, fixed in alcohol and measured in water, are 0.066–0.072 mm long by 0.054–0.057 mm broad, with a knob-like projection at the smaller pole; the contained ovum is not segmented. The small vitelline follicles form a thin layer around the muscle sheath, and also extend into the salient posterior borders.

TENTACULARIIDAE Poche, 1926

42. *Tentacularia coryphaenae* Bosc, 1802

Syn. *Stenobothrium macrobothrium* (Rud., 1810)

This cosmopolitan species well known as *Tetrarhynchus macrobothrius* Rud. or *Stenobothrium macrobothrium* (Rud.) should be called by the larval name given by Bosc according to the rule of priority. I will give an account of its anatomy with special reference to some important characters.

The material was obtained from the small and large intestines of *Prionace glauca* (Linn.) and the spiral intestine of *Scoliodon walbeehmi* (Bleeker) at Kuki. The largest mature alcoholic specimen is 54 mm long by 2.4 mm broad and its scolex 11.5 mm long by 1.9 mm broad. The slender proboscides attain a length of about 1.0 mm when fully everted. The stout solid proboscis hooks, 0.03–0.04 mm long and arranged in regular spirals, are almost uniformly rose-thorn-shaped, except at the swollen base of the proboscis where they are exceedingly small. The narrow, flat bothria, with the marginal grooves closely beset with long hairs, extend to near the anterior end of the strobila. Each proboscis sheath has at its posterior end a hollow muscular nodule about 0.054 mm in diameter, apparently a local thickening of the muscular wall of the proboscis sheath, with a small lumen covered by the folded lining of the sheath. The elongate muscular bulbs about 0.81 × 0.21 mm and with the retractor attached to its posterior end, lie about one-eighth the scolex length from the anterior end. The velum, about 2.0 mm long, is sometimes strongly flared and sometimes closely applied to the anterior end of the strobila. The black pigmentation of the scolex, usually most intensive at the anterior end, is subject to much individual variation. Strong sulphureous smell of the host gut when opened leads one to suppose that the pigment is probably a certain compound of sulphur.

The segmentation begins at the level of the posterior end of the velum. The anterior end of the strobila is more or less attenuated, especially when the velum is strongly flared. The proglottides at first exceedingly short become gradually longer posteriorly, but even the gravid ones are still definitely broader than long (about 0.66 × 2.78 mm); their lateral margins are straight or convex and the posterior linear and not prominent. The strongly developed subcuticular longitudinal muscles form a double layer, of which the inner consists of powerful bundles intruding into the subcuticular cell layer. There is no typical inner

Fig. 131

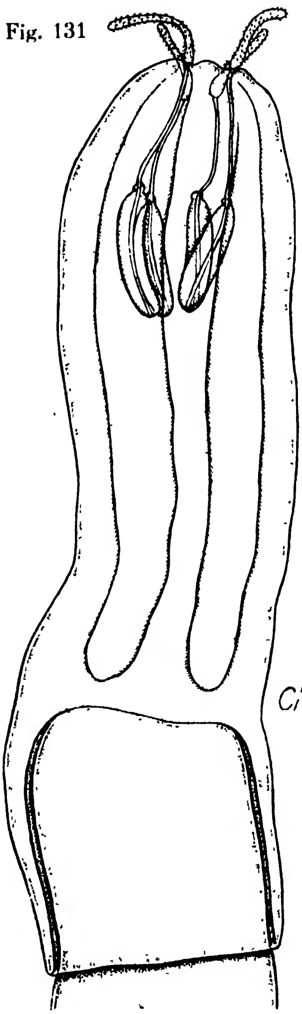

Fig. 132

Fig. 133

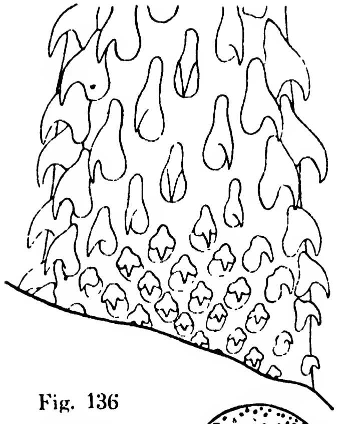

Fig. 136

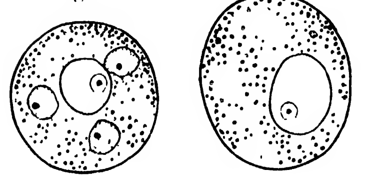

Fig. 134

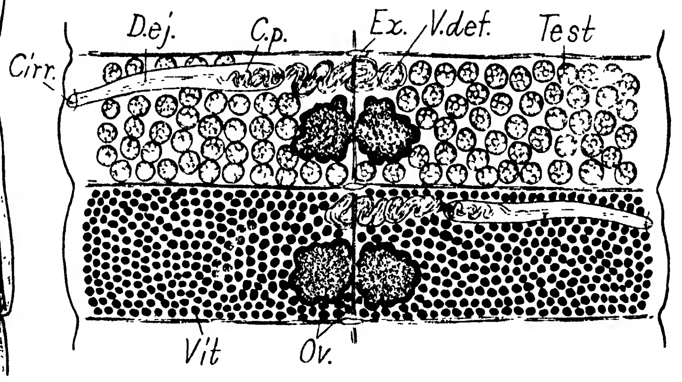

Fig. 135

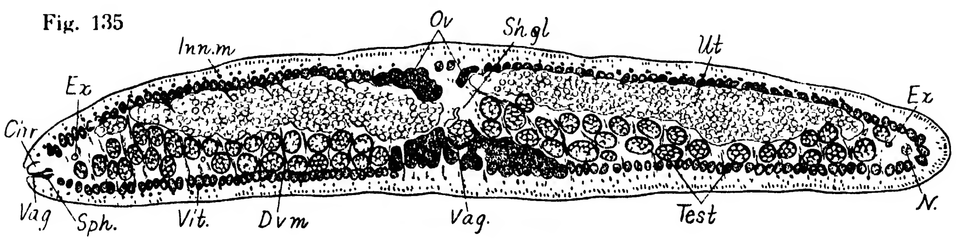

Fig. 131–136. *Tentacularia coryphaenae* Bosc, 1802.
Fig. 131. Scolex. 11.5 mm long. Fig. 132. Hooks at apex of proboscis. Fig. 133. Hooks at base of proboscis. Fig. 134. Maturing proglottides. Testes and vitellaria shown in different segments. Fig. 135. Transverse section of gravid segment. Fig. 136. Eggs. 36–41 × 29–35 μ.

longitudinal muscle sheath. In the median plane of the strobila there is a continuous dorsal and a ventral muscle band running between the paired dorsal and ventral wings of the ovary. The dorsoventral muscle fibers are highly developed and give rise to a conspicuous dotted appearance in total mounts.

The main excretory system of each side consists of a wide thin-walled lateral vessel on the inner side of the nerve trunk and a narrow thick-walled medial one, parallel to each other and like the nerve trunk, passing on the ventral side of the cirrus pouch and vagina. In addition there are two or more pairs of relatively large vessels passing among the testes or between these and the uterus on the inner side of the stems mentioned above. The interproglottidal excretory vesicle opens dorsally as in *Nybelinia* The relatively large nerve trunk runs along the lateral edge of the medulla.

The numerous testes lie close together in the medulla but separated from one another by the dorsoventral muscular septa, and on the dorsal side of the uterus in gravid segments. The wide thin-walled vas deferens forms a transversely elongate compact mass of coils on the atrial side of the median line at the anterior end of the proglottis. The cylindrical muscular cirrus pouch lies along the anterior border of the proglottis, and contains a narrow convoluted ductus ejaculatorius and a straight protrusible cirrus. There is no vesicula seminalis interna. The submarginal genital pores lie in front of the middle of the lateral margin and are irregularly alternate.

The median ovary, X-shaped in transverse section and consisting of paired dorsal and ventral wings with lobulated borders, is 0.25–0.38 × 0.62–0.75 mm in gravid segments, one-fourth to one-fifth as broad as the proglottis. The shell gland complex lies directly behind the central part of the ovary. The coiled uterine duct fills up the space between the ventral ovarial wings. The gravid uterus is a very spacious sac extending on the ventral side of the testes to near the lateral excretory stems, and divided into compartments by dorsoventral muscular trabeculae. The subglobular, thin-shelled, non-operculate eggs measure 0.036–0.041 × 0.029–0.035 mm; the ova are not segmented. The vagina opening directly ventral to the cirrus and with a conspicuous sphincter, passes medially along the cirrus pouch and is markedly expanded before opening into the seminal duct. The vitelline follicles form a continuous layer around the testes and uterus.

13. *Nybelinia pintneri* n. sp.

Description of Adult. This species was found in the stomach of *Prionace glauca* (Linn.) at Kuki. The largest specimen is 30 mm in length and 2.1 mm in breadth. The elongate bothridia, 1.0 × 0.35 mm and with long hairs on the free margins are in dorsal and ventral pairs, with the concave margins turned face to face. The cylindrical proboscis, 0.8 × 0.05 mm, bears about 33 spiral rows of stout, strongly recurved hooks which become slightly smaller posteriorly and measure approximately 0.015 mm in maximum length. At the base of the proboscis the otherwise simple roots of the hooks are

Fig. 137

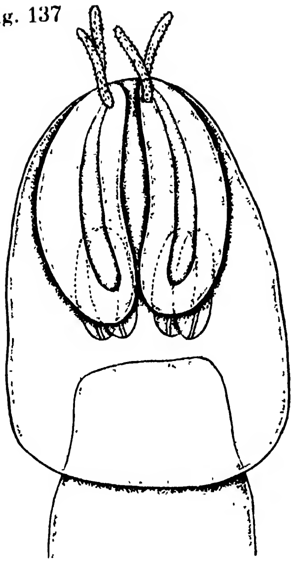

Fig. 139

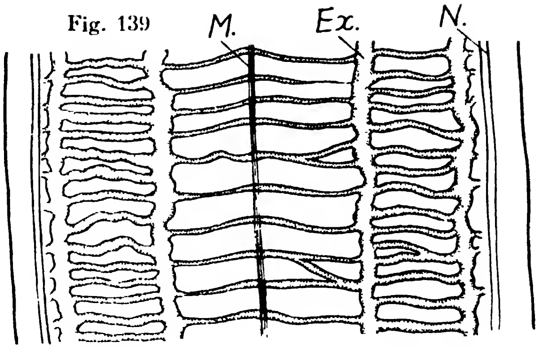

Fig. 140

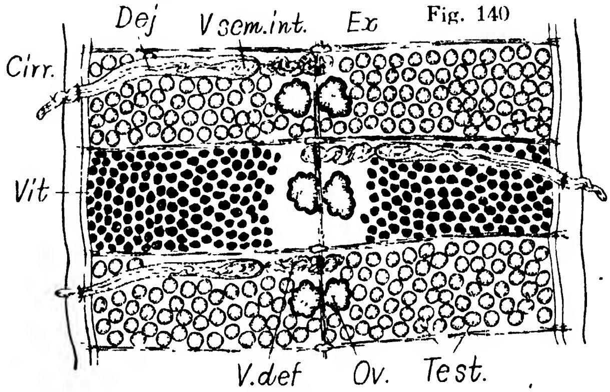

Fig. 141

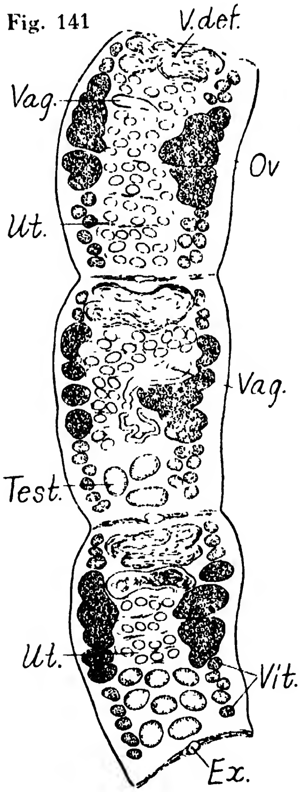

Fig. 142

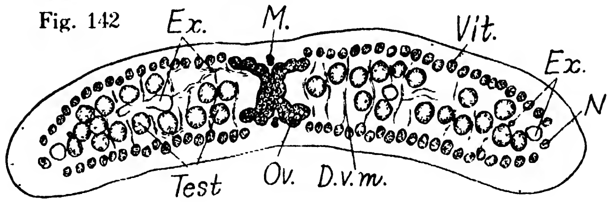

Fig. 143

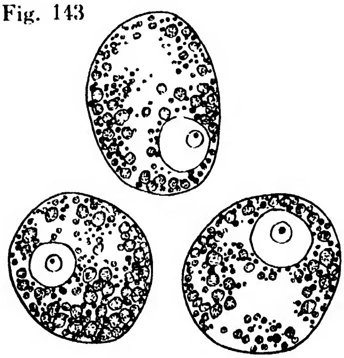

Fig. 138

Fig. 137–143. *Nybelinia pintneri*. Fig. 137. Scolex in surficial view. Fig. 138. Proboscis.

0.8×0.05 mm. Fig. 139. Excretory system in anterior proglottides. Fig. 140. Maturing segments; ventral view. Testes and vitellaria shown in different segments. Fig. 141. Frontal section of gravid segment. Fig. 142. Transverse section of maturing segment. Fig. 143. Eggs. 38–46×27–38 μ.

prolonged backward. The proboscis sheath is short. The muscular bulbs, about 0.375×0.15 mm, lie for the most part in the pars bothridialis, with their posterior ends extending to near the anterior end of the strobila. The relatively slender retractor of the proboscis is attached to the extreme posterior end of each bulb, from which strong muscular bundles diverge toward the anterior end of the strobila. The somewhat flared velum, 0.37–0.55×1.0–1.3 mm, is slightly constricted at its base. In the central part of the pars bothridialis there is a very conspicuous mass of cells, probably "X-organ" of Pintner.

The strobila is almost uniformly broad, except at the two extremities, of which the anterior, enclosed in the velum, is a little narrower than the following part, and the posterior is more or less pointed; the lateral margins are straight in immature proglottides, and only slightly convex and tending to roll in ventrally in mature ones. There is no overlapping of the posterior borders. The gravid proglottides are broader than long and measure about 0.63×2.1 mm.

The cuticle is delicate. The subcuticular longitudinal muscles are well developed. There is no definite inner longitudinal muscle sheath. The dorsoventral muscles form very strong septa among the genital organs. A conspicuous median muscle band of closely massed fibers runs the whole length of the strobila, between the two lateral lobes of the ovary, both dorsally and ventrally.

The wide lateral excretory vessel lying directly medial to the nerve trunk is connected with the submedian stem by wide transverse commissures. The small median vesicle opening dorsally and enclosed in the muscular inter-proglottidal septum also communicates with the submedian stem.

The testes, 100–120 in number for each proglottis, lie close together in two or three layers, filling up all the available space enclosed by the layer of vitellaria and the lateral excretory stems mentioned above. The cylindrical, strongly muscular cirrus pouch extends first obliquely forwards to near the anterior margin of the proglottis, then transversely toward the median line, and terminates anterolateral to the ovary. It contains a smooth protrusible cirrus, a narrow sinuous ductus ejaculatorius and a small vesicula seminalis interna. The irregularly alternate, ventromarginal genital pores lie in front of the middle of the proglottis. The relatively wide, thin-walled vas deferens is strongly convoluted at the anterior end of the proglottis in front of the ovary.

The median ovary, X-shaped in transverse section, has irregularly lobulated margins, and is in mature and gravid segments only one-sixth to one-seventh the breadth of the proglottis. The germiduct arising from the oocapt at the central part of the ovary passes ventroposteriorly and then turning dorsad receives the seminal duct. The shell gland lies just behind the middle part of the ovary. The uterine duct describes several loops behind the ovary before becoming the uterus proper, which extends forwards to the coils of the vas deferens and when filled with eggs forms a very voluminous sac divided by the ovary and vagina into two lateral chambers. The subglobular to oval thin-

shelled, non-operculate eggs, 0.038–0.046 × 0.027–0.038 mm, are more or less irregular in outline and contain each an unsegmented ovum. The straight distal part of the vagina runs parallel to the cirrus pouch on its posterodorsal side, and the very wide sigmoid proximal half is continued into the seminal duct at the level of the oocapt. The poorly developed vitelline follicles form a continuous layer immediately under the subcuticular cells.

DESCRIPTION OF LARVA. A plerocercoid of this species was found encapsulated in the mesentery of *Paralichthys olivaceus* (Temm. et Schl.) from Kuki, and has already a distinctly segmented strobila measuring 3.7 × 0.43 mm. The scolex is 1.54 mm long and 0.63 mm broad at the level of the posterior ends of the bothridia. The proboscides, 0.62 × 0.03 mm, bear each about 33 spiral rows of strongly recurved hooks up to 0.015 mm long, with broad, posteriorly attenuated base. The elongate bothridia, 0.96 × 0.25 mm, are arranged as in the adult and extend to near the anterior end of the strobila. The elliptical muscular bulbs, 0.41 × 0.2 mm, are almost entirely overlapped by the posterior part of the bothridia. The slightly flared velum is 0.5 mm long by 0.66 mm broad. The rudimentary strobila has a very conspicuous dorsal and ventral median muscle band and consists of over one hundred lightly marked segments.

The above description will show that the larva before us is to be assigned to *Nybelinia pintneri*.

DISCUSSION. This species resembles *Tetrarhynchus palliatus* Linton, 1924, and *Stenobothrium palliatum* (Linton) of Pintner (1929), but its strobila is rather related to *Tetrarhynchus bisulcatus* Linton, 1889, or *T. robustus* Linton, 1890. According to Southwell's descriptions, it differs from *Tetrarhynchus perideraeus* Shipl. et Horn., 1906, in the number and arrangement of testes, the characters of proboscis hooks and the size of eggs, and from *T. herdmani* Shipl. et Horn., 1906, in the size of proboscis hooks as well as of eggs. Shipley and Hornell's statement that there are two bothridia in *T. herdmani* is obviously erroneous.

Fig. 144

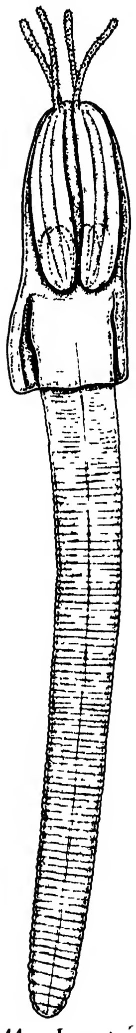

Fig. 144. Larva of *Nybelinia pintneri* encapsulated in mesentery of *Paralichthys olivaceus.*

Nybelinia pintneri n. sp.

SPECIFIC DIAGNOSIS. *Nybelinia* Poche, 1926. Body up to 30 × 2.1 mm. Bothridia 1.0 × 0.35 mm. Proboscides 0.8 × 0.05 mm. Proboscis hooks stout, strongly recurved, 0.015 mm long. Muscular bulb 0.375 × 0.15 mm, extending a little farther backwards than bothridia. Velum 0.37–

0.55×1.0–1.3 mm. Proglottides definitely acrasped, broader than long throughout. Testes 100–120, in two or three layers. Vesicula seminalis interna present. Genital pores irregularly alternate, ventromarginal, pre-equatorial. Ovary small, $^1/_6$–$^1/_7$ of proglottis breadth. Uterus divided into two voluminous lateral chambers when fully gravid. Egg subglobular to oval with irregular outline, 0.038–0.046×0.027–0.038 mm; ovum not segmented. Larva in *Paralichthys olivaceus* (Temm. et Schl.).

Habitat. Stomach of *Prionace glauca* Müller et Henle.

Locality and date. Pacific coast of Mie Prefecture; March 30, 1927.

Type and paratypes in my collection.

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Sphyriocephalidae Dollfus, 1930

44. *Sphyriocephalus viridis* (Wagener, 1851) Pintner, 1913

I found this worm on October 18, 1926, in the stomach of *Isurus glaucus* (Müller et Henle) from the Pacific. A comparison of my specimens with Pintner's detailed account shows some errors in the latter, as pointed out below.

On the basis of examination of sections Pintner states (1913, p. 213), "Die Eier von Tetrarhynchus viridis Wagener haben keine Filamente, wohl aber an beiden Polen kleine, zugespitzte Zipfel. Reichen diese Fortsätze auch nicht im Entferntesten an die Anhängsel der Eier der anderen Form heran, so sind sie doch wohl Andeutungen einer homologen Bildung, die mit auf die Verwandschaft der beiden Formen hinweist." I also could not detect the polar filaments in sections, but in whole mounts of gravid segments they are clearly recognizable. The long filament borne by the narrower pole of the egg is up to 0.3 mm long and consists of a solid, narrow terminal piece 0.02 mm long and a relatively broad, flexible shaft containing yolk cells and constricted at the base. The short slender filament with a hollow, broad base is up to about 0.05 mm long and borne not exactly opposite the longer filament, but a little towards the somewhat flattened side. The egg proper measures on the average 0.072×0.05 mm in sections, though definitely smaller when collapsed.

Since there cannot be such a remarkable difference in egg characteristics as indicated by Pintner between two species of the same genus, an error is evident and the differential character of the egg filaments should be excluded from Pintner's key to *S. viridis* and *S. tergestinus* (1930, p. 463). At the distal end of the vagina there is a definite sphincter overlooked by Pintner.

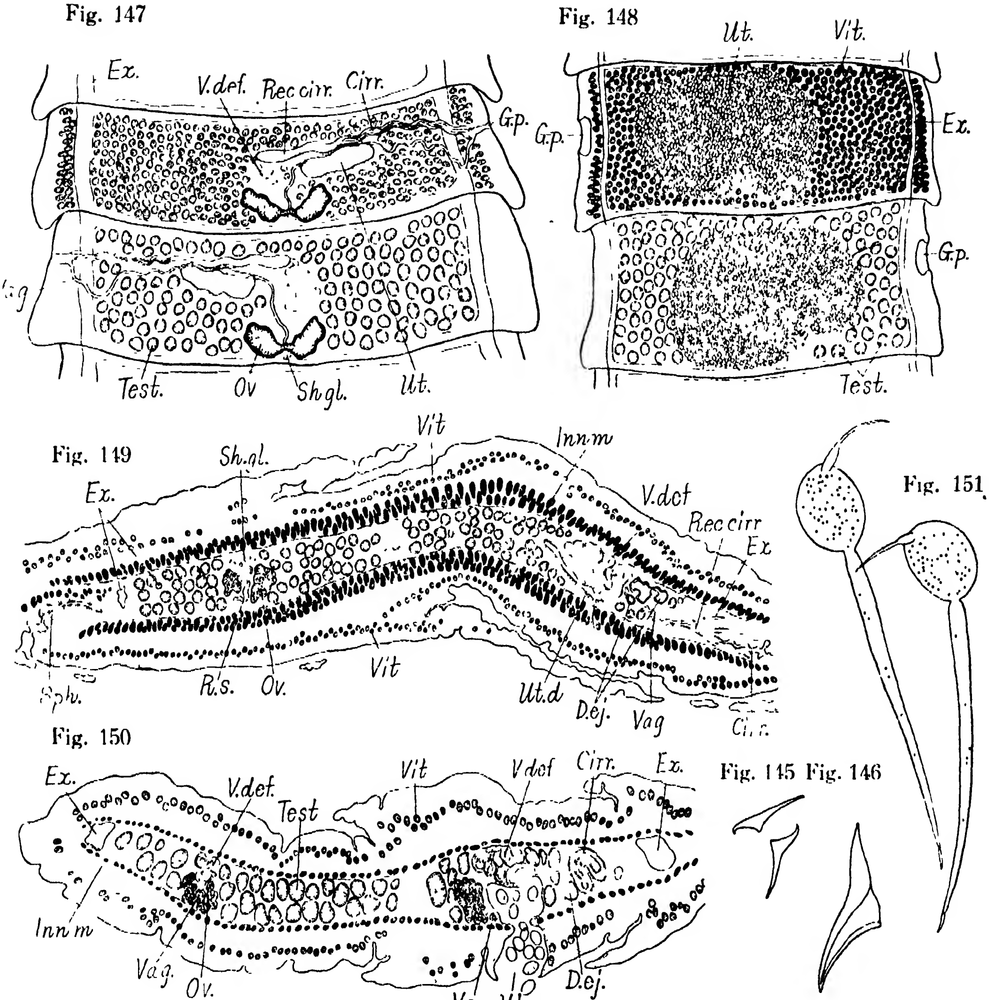

Fig. 145-151. *Sphyriocephalus viridis* (Wagener, 1854). Fig. 145. Hooks at base of proboscis. Fig. 146. Hook at middle of proboscis. Fig. 147. Mature segments; ventral view. Anterior segment 0.62×2.6 mm. Fig. 148. Gravid segments; ventral view. Anterior segment 1.6×3.6 mm. Testes and vitellaria shown in different segments. Fig. 149. Transverse section of mature segment. Fig. 150. Transverse section of gravid segment. Fig. 151. Eggs.

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Floricipitidae Dollfus, 1929

45. *Floriceps elongatus* (Rud., 1819)

Description. Two specimens were found on October 18, 1926, in the spiral intestine of *Isurus glaucus* (Müller et Henle) from the Pacific. One of them is 17 mm long and the other about 20 mm long. It is very curious that the completely invaginated proboscides of the former are entirely hookless. In the latter specimen, however, the proboscides, 0.15–0.2 mm wide, are armed with slightly spiral rows of large hooks of unequal size and shape, interrupted on the inner side of the proboscis by a few longitudinal series of minute thorn-shaped hooks 0.018–0.024 mm long. Of the large hooks, one sort opposite the longitudinal series is broad, stout and abruptly recurved, while the other is spinose, 0.04–0.1 mm long and tapers gradually to an acute point, but both with a prominent, posterior basal prolongation. Near the base of each proboscis there are several oblique circles of small spines and a group of 8–9 bluntly pointed hooks arranged in quincunx, the largest, approximately 0.17 mm long and with a simple attenuated base, lying on the outer side of the proboscis, and the others becoming gradually smaller toward the inner side of the proboscis, some with a very broad base. The basal invaginated hookless part of the proboscis is coarsely corrugated transversely. The ear-shaped bothridia, 1.8 × 0.63 mm, are in dorsal and ventral pairs, with their thick posterior borders almost in contact with each other. Coarse muscular bundles arising from the inner muscular layer of the scolex are attached to the strongly sinuous proboscis sheath, which is about 0.1 mm broad. There is a muscle ring, 0.15–0.2 mm long, at the posterior end of each proboscis sheath. The oblong bulb is 1.8 mm long; the number of its lamellae is unknown. Exceedingly powerful muscular bundles attached to the posterior ends of the bulbs are continued into the inner longitudinal muscle sheath of the strobila. The proboscis retractor reaches to the posterior end of the bulb. The three anterior parts of the scolex (pbo, pvag and pbulb after Pintner) are of equal length (1.8 mm) and the postbulbosa is about 0.3 mm long in one specimen, while in the other it is telescoped into the Keimlager of Pintner, which is sharply marked off from the preceding region.

The transversely oblong anterior segments gradually increase in length posteriorly and the mature ones are definitely longer than broad and slightly constricted at the segmentation line. The cuticle is about 0.01 mm thick on the bothridia and 0.005 mm on the proglottides, but much thicker on the pars vaginalis and pars bulbosa, partly due to corrugation. The outer circular and the inner longitudinal, subcuticular muscle layers as well as the underlying cell layer are well developed. The inner longitudinal muscle sheath is especially powerful in the anterior segments. There is a thin transverse muscle layer directly inside this sheath, forming the outer boundary of the medulla.

The main excretory system consists of a wide ventrolateral and a narrow thick-walled dorsomedial vessel, both lying close together dorsal to the cirrus

Fig. 153

Fig. 152

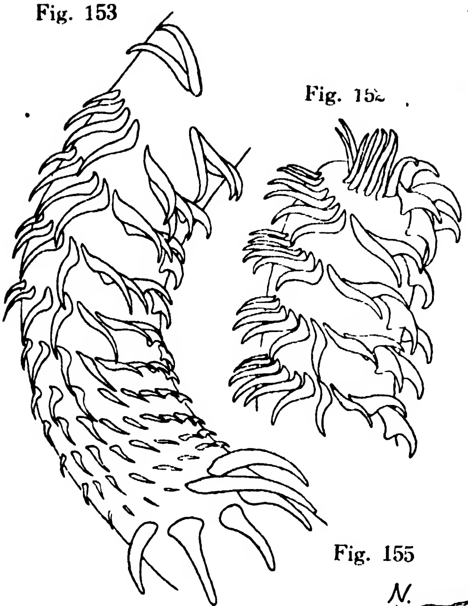

Fig. 154

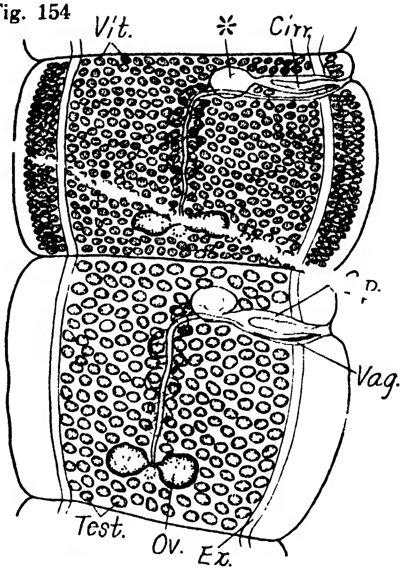

Fig. 155

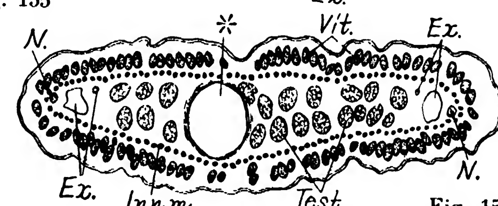

Fig. 156

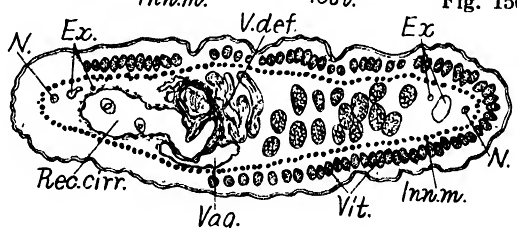

Fig. 157

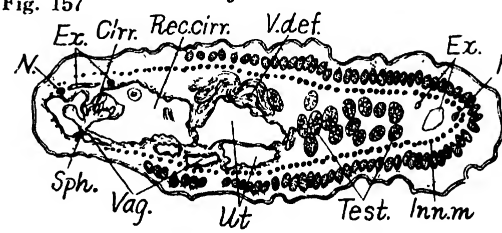

Fig. 152–157. *Floriceps elongatus* (Rud. 1819).
Fig. 152. Anterior hooks of proboscis.
Fig. 153. Posterior and basal hooks of proboscis.
Fig. 154. Maturing segments; ventral view. Testes and vitellaria shown in different segments. *Cirromotionsblase of Zerny.
Fig. 155–157. Transverse sections of mature segment. *Cirromotionsblase of Zerny.

and vagina in the lateral medulla just on the inner side of the nerve trunk, which runs on either side between the ventral excretory stem and the lateral edge of the muscle sheath.

The extremely numerous testes, closely arranged in two or three layers and with their long axes directed dorsoventrally or transversely, occupy the entire available space of the medulla. The coils of the wide vas deferens extend

in the median line along the dorsal wall of the uterus and of the "Cirromotionsblase" of Zerny. The globular, thick-walled seminal vesicle ("Vesicula expulsatoria" of Pintner), about 0.13 mm in diameter and filled with spermatozoa, lies posterodorsal and slightly lateral to the "Cirromotionsblase". The latter, a very conspicuous roundish organ, 0.24 × 0.2 mm in transverse section and lying a little to the atrial side of the median line, has a thick wall of circular muscle fibers and an epithelial lining like that of the vesicle mentioned above. I regard it as a diverticle of the ejaculatory duct. The transversely elongated "Penisscheide", which I propose to call receptaculum cirri, has a poorly developed muscular wall lined by a very thin epithelium, and should be looked upon as the expanded distal end of the ejaculatory duct*, into which the cirrus can be retracted. The slender cirrus coiled in its receptacle opens directly dorsal to the vagina into the genital atrium, which in turn opens on the lateral margin near its anterior end, the opening of the two sides alternating irregularly but with a tendency to unilateral arrangement. The atrial aperture may be compressed dorsoventrally or eventually closed by the inner longitudinal muscular bundles which are here particularly well developed. There is, however, no distinct sphincter, though Pintner says "von sphincterartigen Muskeln umgeben".

The ovary, separated from the posterior end of the proglottis by a narrow testicular zone, consists of two compact lateral lobes with several longitudinal furrows on the dorsal and ventral surfaces, as pointed out by Pintner. The shell gland lies behind the middle of the ovary. The uterus is a tube with a somewhat sinuous wall in immature proglottides, but in gravid ones an elongate sac extending forwards in the median line to the level of the posterior end of the seminal vesicle. Distally it tends to curve toward the atrial side and gives off a ventral pouch behind the transverse part of the vagina. The true uterine pore could not be definitely located in the specimens at my disposal. The uterine eggs have been greatly deformed by shrinkage. The vagina, with a not very conspicuous sphincter around its opening, passes medially on the ventral side of the receptaculum cirri and after crossing over the ventral pouch of the uterus mentioned above, continues into the median descending part in close contact with the uterus on its ventral side. It is considerably enlarged for the greater middle part.

The small vitelline follicles form a thick mantle covering the inner muscle sheath, with a broad interruption on the ventral side of the terminal genital ducts and a narrower one on the dorsal, as also at the small ovarian area.

The above description conforms in every essential particular to that of Pintner based on specimens from Ceylon. The larval form was found on April 2, 1927, in the liver of *Mola mola* (Linn.) from the same locality where the adult was obtained.

*Pintner says (1913, p. 216) "Der Hohlraum im Cirrusbeutel ist also allerdings, wie Zerny will, ein Teil des Vas deferens-Lumens, beziehentlich eines als Vesicula weit aufgetriebenen Abschnittes dieses Organs".

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TETRARHYNCHIDEA sedis incertae

46. *Dasyrhynchus ingens* (Linton, 1921) Pintner, 1928

Pintner found this species in the collection made by Sixten Bock during his expedition to Japan and Bonin-Islands. The host fish is said to be a *Carcharias* species, probably *C. glaucus* (L.). I also found it on March 30, 1927, in the spiral intestine of *Prionace glauca* (Linn.) from the Pacific coast of Mie Prefecture.

Since the worm was described by Linton in considerable detail, I shall give here a brief account of my material. The largest gravid specimen at my disposal is about 21 cm long and 1.0 mm broad at the posterior end of the middle third. The scolex, 8.5 mm long, is sharply marked off from the strobila, into which its posterior end is slightly invaginated; the cylindrical contorted proboscis is about 2.0 mm long and 0.15 mm broad, the hooks not taken into account. The largest, strongly recurved hook is 0.078×0.015 mm and one of the chain-like series is 0.06 mm long. The arrangement of the hooks is just as in Linton's specimens. The bothridia, 1.31×1.75 mm and with long marginal hairs, have a deep median constriction on the posterior border. The pars vaginalis, 4.3×1.9 mm, has transverse wrinkles which are less numerous than in Pintner's specimen. The pars bulbosa has two indefinite constrictions, with an interval of about 1.5 mm. The slightly sinuous muscular bulbs 3.2 mm long extend for about 0.25 mm into the strobila. The latter is not distinctly segmented in the anterior part but the gravid proglottides are more or less sharply marked off, almost moniliform posteriorly and easily detachable. The postequatorial marginal genital pores are irregularly alternate. The median uterine opening lies near the anterior border of the proglottis and in the broadest part of the strobila can be seen with the naked eye as a brown spot. The well developed subcuticular longitudinal muscles run diffusely in the cortical parenchyma. In the anterior segments the inner muscle sheath is composed of extremely strong longitudinal bundles occupying the greater part of the parenchyma, but in the posterior segments it is less strong. The transverse muscle layer enclosing the medulla passes through the lateral edges of the muscle sheath into the cortex.

The nerve trunk and the main excretory vessels, a wide lateral and a narrow dorsomedial, lie dorsal to the cirrus and vagina.

The testes filling all the medullary space between the two lateral excretory stems and extending into the interspace between the dorsal and ventral lobes of the ovary, contain concentric layers of spermatozoa, as described by Linton. The coiled vas deferens lying dorsal to the uterus extends laterally among the testes toward the proximal end of the cirrus pouch, where it leads into the

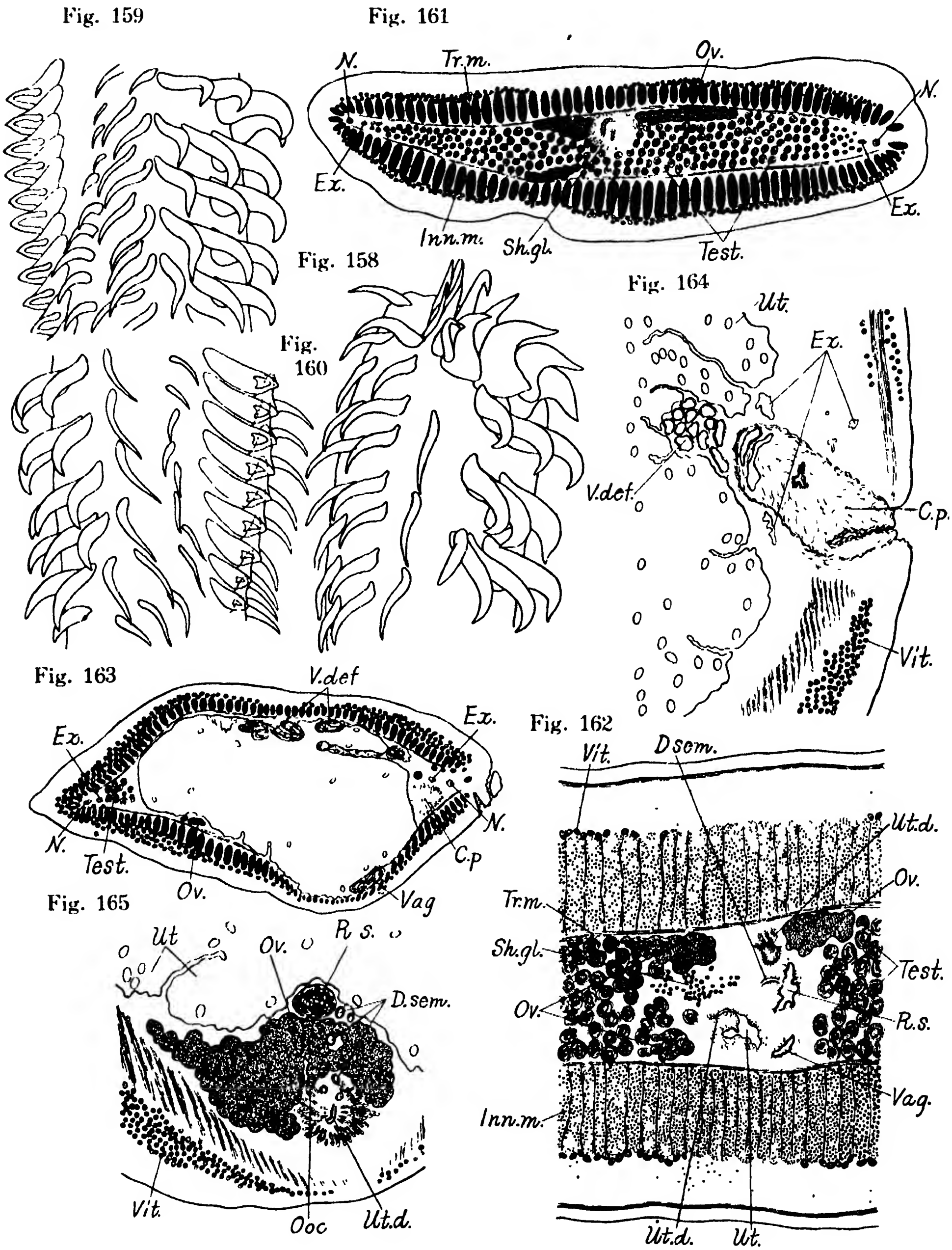

Fig. 158–165. *Dasyrhynchus ingens* (Linton, 1921). Fig. 158. Anterior hooks of proboscis. Fig. 159. Posterior hooks of proboscis on one side. Fig. 160. Same on opposite side. Fig. 161. Transverse section of young proglottis. Fig. 162. Same, showing female genital complex. Fig. 163. Transverse section of gravid segment. Fig. 164–165. Frontal sections of gravid segment.

ductus ejaculatorius. In gravid segments the proximal part of the ductus ejaculatorius forms the vesicula seminalis externa, while the distal part at the base of the cirrus pouch serves as vesicula seminalis interna or as receptaculum cirri when the cirrus is drawn in; in maturing proglottides the cirrus is seen projecting into the receptaculum cirri. The cirrus pouch is variable in shape in accordance with the state of contraction; it is elongate in young proglottides, but elliptical or ovoid in gravid ones, with its proximal end directed anteromediad; its wall consists of markedly wavy musculature, and the hollow of the pouch is filled with coarse muscle fibers running in various directions, suggesting great contractility. The genital pore lies at the bottom of a funnel-shaped depression beset with numerous small cuticular papillae.

The ovary, X-shaped in transverse section, extends for some distance on either side of the median line. The germiduct arises from the oocapt on the posterior surface of the middle of the ovary with the shell gland complex posterodorsal to the latter. The convoluted uterine duct lies between the ovary and the uterus, and opens into the latter at its posterior end from the dorsal side. In young proglottides, the uterus has a thick coat of deeply staining cells, but when filled with eggs it becomes an enormous sac occupying the greater part of the proglottis and divided by parenchymatous septa into numerous compartments, accompanied by marked atrophy of the testes, muscle sheath, etc. The oval, thin-shelled uterine eggs, fixed in alcohol and measured in water, are 0.054–0.057 × 0.042–0.045 mm; they are not operculate and contain each an unsegmented ovum.

The vagina is enlarged on the ventral side of the uterus into the receptaculum seminis, and gives off just in front of the middle of the ovary a narrow ductus seminalis, which passes backwards to join the germiduct near its origin. The vitellaria encircling the muscle sheath intrude more or less into the intermuscular space, and some isolated follicles are seen in the lateral area of the medulla; they are interrupted more broadly on the dorsal side than on the ventral.

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Pintner, T. Tetrarhynchen von den Forschungsreisen des Dr. Sixten Bock. Göteborgs Kungl. Vetenskaps- och Vitterhets-samhäll. Handl., Ser. B, Bd. I, No. 8, 1929, p. 35.

47. *Pterobothrium dasybati* n. sp.

Description. A single mature specimen of this species was obtained from the spiral intestine of *Dasybatus akajei* (Müller et Henle) at Tarumi. It is about 34 mm long and has about 60 segments. The scolex is 5.0 mm long and 0.5 mm broad behind the bothridia. The latter are recurved inwards as usual, so that the proboscides projecting at the distal end of the bothridia form a cruciform arch. The short free portion of the proboscides is 0.11 mm broad and bears variously shaped hooks arranged in longitudinal rows. On the inner

Fig. 166

Fig. 168

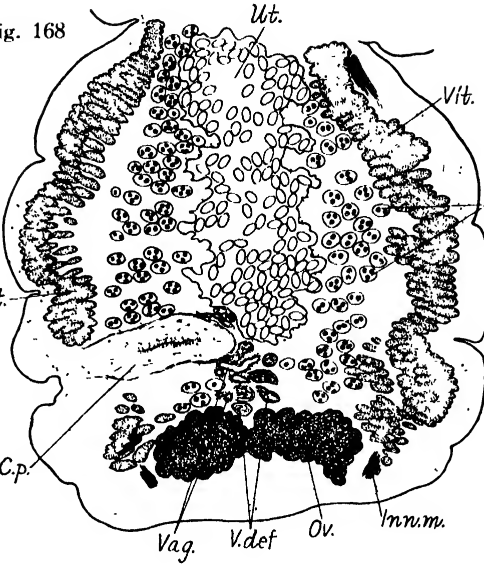

Fig. 167

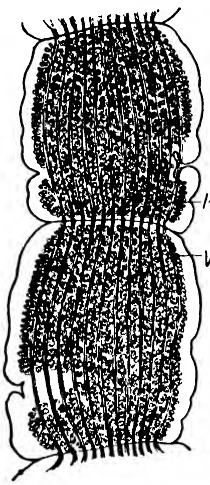

Fig. 170

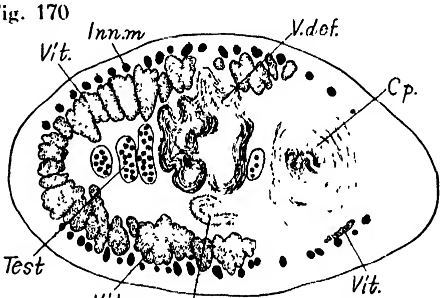

Fig. 171

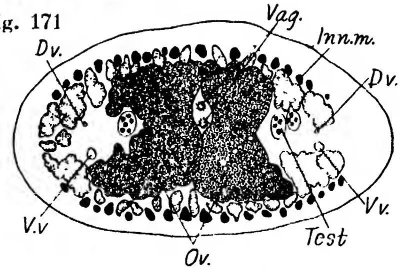

Fig. 169

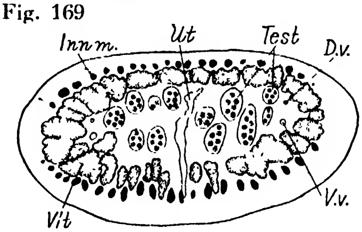

Fig. 166–171. *Pterobothrium dasybati*. Fig. 166. Hooks at about middle of proboscis. Fig. 167. Mature segments in surface view. Fig. 168. Frontal section of gravid segment. Fig. 169–171. Transverse sections of same.

side there is a single row of strongly recurved, stout hooks, 0.13 mm long and 0.1 mm broad at the base. On the outer side, however, there are three kinds of hooks, two of which are small and the other is long and slender. The intermediate hooks between these two sides are conspicuously slender and of dissimilar size and shape. The pars vaginalis is crumpled posteriorly, so that

its length could not be ascertained. The muscular bulbs are about 2.5 mm long by 0.24 mm broad, and have retractor muscles attached to the inner wall. There is no unsegmented neck region. The proglottides are broader than long anteriorly, but longer than broad posteriorly, with a constriction at the level of the genital pore in addition to one at the segmentation line, besides some indefinite ones due to contraction. The powerful inner longitudinal muscular bundles form clearly visible parallel bands.

Of the excretory system there are a wide thin-walled ventral and a narrow, thick-walled dorsal vessel running each just inside the middle of the lateral third of the proglottis.

The exceedingly numerous small testes extend in the medulla through the whole length of the proglottis; the peripheral zone of each appears lamellate and stains deeply with eosin, due to the presence of mature spermatozoa. The compactly coiled, thin-walled vas deferens lies in the median field anterodorsal to the ovary, not reaching to the middle of the proglottis. The elliptical, not very thick-walled cirrus pouch, almost transverse in position and containing a narrow muscular ductus ejaculatorius, extends about one third across the breadth of the proglottis, and is filled with cellular parenchymatous tissue. The short smooth cirrus opens into a deep genital sinus with fleshy borders and situated on the right or left margin of the proglottis, half as far from the posterior end as from the anterior.

The compact, bipartite ovary lies at the posterior end of the proglottis. The germiduct arising from the oocapt at the ovarial isthmus unites with the ductus seminalis and then with the common vitelline duct. The compact shell gland surrounds the coiled proximal end of the uterine duct behind the ovarial isthmus. The median uterus with sinuous walls lies between the ovary and the anterior end of the proglottis, where it opens ventrally. The elongate oval, thin-shelled, non-operculate eggs, fixed in alcohol and measured in water, are 0.042–0.048 × 0.027–0.03 mm; the ova are not segmented. The narrow vagina opening into the genital sinus directly ventral to the cirrus widens gradually as it passes medially behind the cirrus pouch and forms several coils immediately in front of the ovary. The very closely set vitelline follicles lie just inside the longitudinal muscular bundles, partly intruding between them.

Discussion. This species bears a very close resemblance to *Pterobothrium malleum* (Linton, 1924), but differs fundamentally in the disposition of the vitellaria. According to Linton's figure 98 and Southwell's description on page 173, the vitellaria are situated in the cortical parenchyma as well as between the bundles of inner longitudinal muscles, while in my specimen they lie mainly in the medulla and are only partly intermuscular. The specific diagnosis is reserved until additional specimens are available.

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Linton, E. Notes on cestode parasites of sharks and skates. Proc. U. S. Nat. Mus., Vol. 64, Art. 21, 1924, p. 88–90.

Southwell, T. The fauna of British India, including Ceylon and Burma. Cestoda. Vol. 1, London, 1930, p. 160–163.

Tetrarhynchidean Larvae

The following identification is based merely on morphological evidences and lacks experimental basis. The division of tetrarhynchidean larvae into plerocercoids and cysticercoids is not fundamental. For example, the larvae of *Oncomegas* and *Pintneriella*, which are apparently of plerocercoid type and are so referred below, may have passed a cysticercoid stage in their first inter-

Fig. 172

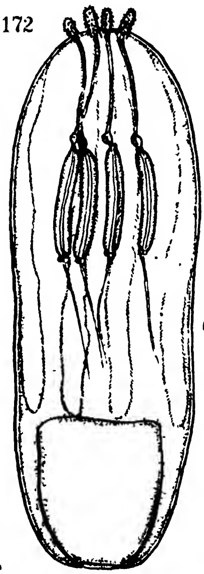

Fig. 173

Fig. 174

Fig. 172. Larva of *Tentacularia coryphaenae* Bosc, 1802, from body cavity of *Euthynnus pelamys*.
Fig. 173. Anterior proboscis hooks of larval *Tentacularia coryphaenae* from flesh of *Scomber japonicus*.
Fig. 174. Basal proboscis hooks of same.

mediate hosts, and this is very probable from their occurrence in a free state in the intestinal tract and flesh of the host fishes.

A. Plerocercoid larvae

1. *Dibothriorhynchus* Blainville. As already mentioned I found the larva of *D. squali* La Martinière, 1797, in the body cavity and on the serous membrane of the stomach and liver of *Prionace glauca* (Linn.) from the Pacific coast of Mie Prefecture.

2. *Tentacularia* Bosc. The plerocercoid larvae found in the body cavity of *Euthynnus pelamys* (L.) and in the flesh of *Scomber japonicus* from Toyama Bay belong to *T. coryphaenae* Bosc, 1802. They vary in length from 2.9 mm

to 11.3 mm. The proboscides are 0.25–0.56 mm long and bear spirally arranged hooks of uniform size and shape; they are somewhat enlarged at the base, where the microhooks are very closely set. The narrow, flat bothridia, 2.8–4.3 mm long, bear stiff hairs in the marginal grooves. Internally the bothridia are sharply demarcated from the surrounding tissue by a thin membranous capsule and contain numerous calcareous corpuscles. The short proboscis sheath has a conspicuous muscular nodule at the posterior end. The muscular bulb, 0.73–1.1 × 0.12–0.18 mm, lies in front of the middle of the scolex. The proboscis retractor appears to be continued through the posterior end of the muscular bulb into the pars postbulbosa. It is very interesting to note that there are two ellipsoidal ganglia immediately behind each muscular bulb.

The velum is closely applied to the anlage of the strobila, which begins at the level of the posterior ends of the bothridia and measures 1.0–1.5 mm in length.

3. *Nybelinia* Poche. According to van Beneden and Vaullegeard, the larva of *N. lingualis* Cuv. occurs in the sole. *N. bisulcata* (Linton, 1889) lives as larva in various teleosts according to Linton and in *Sepia officinalis*, *Octopus vulgaris*, *Trigla gurnardus* and *Conger vulgaris* according to Vaullegeard. A study of Japanese *Nybelinia* larvae which I have collected shows that there are at least three species, one of which is *N. pintneri* mihi already described and the others may be roughly divided into three forms as shown in the following tables.

I. Larger form (2.66–7.6 mm long)

Hosts	Locality	Date
Lotella physis	Toyama Bay	June 22, 1928
Dasycottus setiger	,,	Jan. 17 & June 20, 1928
Bothrocara zesta	,,	Jan. 14, 1928
Cyclogaster owstoni	,,	June 21, 1928
Limanda angustirostris	,,	Jan. 14, 1928
Paralichthys olivaceus	,,	Jan. 13, 1928
Arctoscopus japonicus	,,	June 21, 1928
Hexagrammos otakii	,,	,,
Stereolepis ischinagi	,,	Jan. 17, 1928
Gadus macrocephalus	,,	Jan. 12, 1928
Chirocentrus dorab	,,	Jan. 16, 1928
Ommastrephes sloani pacificus	,,	Jan. 12, 1928

II. Medium form (2.1–3.3 mm long)

Hosts	Locality	Date
Anguilla japonica	Kuki	April 1, 1927

Sebastodes sp.	Kuki	April 4, 1927
Coelorhynchus sp.	"	"

III. Smaller form (0.75–2.3 mm long)

Hosts	Locality	Date
Spheroides spp.	Kuki	April 7, 1927
Rhinoplagusia japonica	Tarumi	Jan. 8, 1928
Harengula zunasi	"	Aug. 24, 1928
Limanda angustirostris	Toyama Bay	Jan. 14, 1928
Paralichthys olivaceus	"	Jan. 13, 1928
Etrumeus micropus	"	Jan. 15, 1928
Sepiella maindroni	"	April 19, 1929

Those of the larger form are very common in bottom and pelagic fishes as well as in cephalopods. Their measurements in mm are as follows: bothridia 1.1–2.7 × 0.23–0.63; proboscis 0.8–1.2 × 0.08–0.1; proboscis hooks 0.027–0.036; muscular bulbs 0.3–1.0 × 0.15–0.38; tail (anlage of strobila) 1.1–3.8 × 0.38–1.3.

P. surmenicola Okada belongs to this category.

The larva from *Goniistius magister* is 10.43 mm long, and its tail, 4.75 mm long, projects out of the velum for more than half its length; the bothridia are 2.68 × 0.87 mm and the muscular bulbs, 1.0 × 0.32 mm, are 2.0 mm away from the base of the tail.

Larvae of the medium form, whose adults are as yet unknown are characterized by the size of the proboscis hooks (0.064–0.07 mm long) and the muscular bulbs being nearly as long as the bothridia. They may belong to different species, but I have no positive evidence on this point.

The smaller form may also include different species, but it seems almost certain that the larva from *Sepiella maindroni* belongs to *N. bisculcata* (Linton, 1889). It is 1.03 mm long by 0.5 mm broad; the bothridia are 0.525 × 0.275 mm and the muscular bulbs 0.25 × 0.11 mm; the tail is 0.25 × 0.2 mm; the proboscis hooks, 0.012 mm long, are arranged in regular spirals. The dorsal excretory vessels open into the vesicle medial to the ventral ones. The measurements in mm on the other examples of this form are as follows: bothridia 0.25–0.75 × 0.15–0.5; proboscis 0.14–0.28 × 0.024–0.03; proboscis hooks 0.015–0.021; muscular bulbs 0.23–0.45 × 0.05–0.16; tail (anlage of strobila) 0.15–0.7 × 0.1–0.33.

4. *Oncomegas* Dollfus, 1929. The larva of *O. wageneri* (Linton, 1890), characterized by having a basal macrohook 0.036–0.045 mm long, was found in the intestinal tract of *Conger myriaster* and *Ophisurus macrorhynchus* from the Pacific coast of Mie Prefecture. The scolex proper is 2.9–3.4 × 0.35–0.4 mm

and the caudal appendage 4.0–5.0 × 0.47–0.7 mm. The bothridia are only 0.38–0.43 mm long and the muscular bulbs 1.1-1.3 × 0.12–0.16 mm. The proboscis hooks of one side are stout and strongly recurved, but those of the opposite side are definitely smaller, the intermediate ones being more or less slender and up to about 0.03 mm long. The complex of the basal hooks is represented in fig. 176. The proboscis retractor is attached to the base of the muscular bulb. The caudal appendage is distinctly segmented off from the scolex proper 0.45–0.66 mm behind the muscular bulbs. Two similar, contracted specimens, whose anterior end is invaginated into the body with the posterior borders of the bothridia directed forward, were found in the pyloric ceca of *Lophius litulon* which had been preserved in the museum of the Seto Marine Biological Laboratory. In one of them the scolex proper measures 1.87 × 0.56 mm and the caudal appendage 5.5 × 0.375 mm. The basal macrohook with a bifid root is 0.045 mm long by 0.029 mm broad at the base.

Fig. 176 Fig. 177

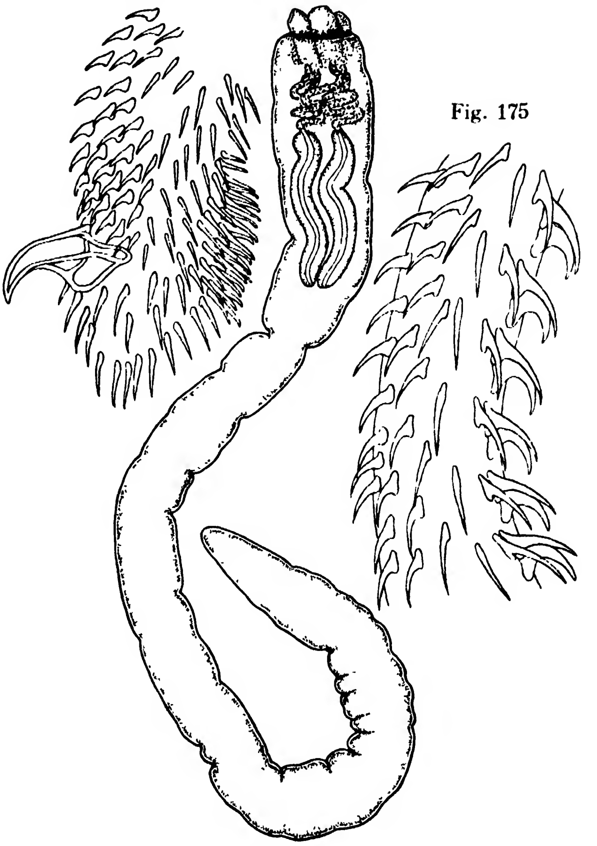

Fig. 175

Fig. 175–176. Larva of *Oncomegas wageneri* (Linton, 1890) from *Conger myriaster*.
Fig. 175. Anterior proboscis hooks.
Fig. 176. Basal proboscis hooks.
Fig. 177. Larva of *Oncomegas* sp. from pyloric cecum of *Lophius litulon*.

5. *Pintneriella* n. g. Plerocercoid larvae resembling *Tetrarhynchus scolecinus* Rud., 1819, were found free in the flesh of *Pagrosomus unicolor* and *Epinephelus akaara*. It consists of the scolex and a long cylindrical caudal appendage. The cuticle is 0.006–0.01 mm thick, but definitely thinner at the apex. The circular and longitudinal subcuticular as well as the inner longitudinal muscles are well developed. The flat, surficial bothridia, 0.97–1.6 mm long, have a smooth margin with an inconspicuous posterior notch. The proboscides are only slightly everted in a single specimen, so that the slender posterior hooks and the closely massed basal microhooks alone could be made out. The strongly

Fig. 179

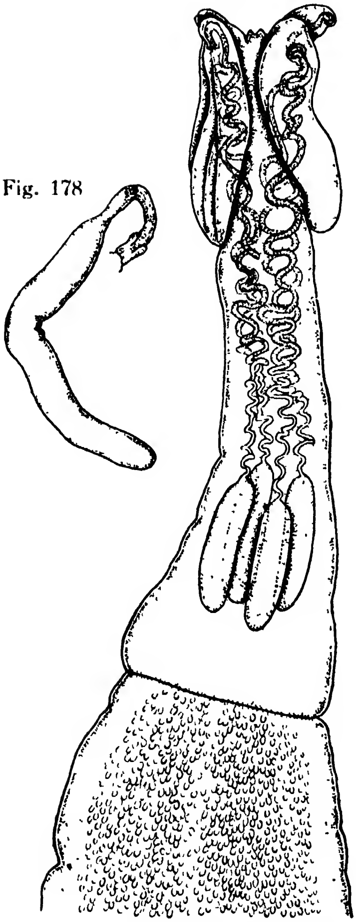

Fig. 178

Fig. 178. *Pintneriella musculicola.* Type 25.2 mm long.
Fig. 179. Anterior portion of same.

twisted proboscis sheath has a small bulbous swelling at its posterior end. The muscular bulb measuring 0.54–0.8 × 0.18–0.35 mm, has a retractor attached to its base. The pars postbulbosa which is strongly stained with carmine is about 0.37 mm long by 1.0 mm broad, has a posteriorly broadened base and is usually sharply demarcated from the caudal appendage by a transverse fold.

The caudal appendage, 18–21 × 1.6–1.8 mm, has more compact tissue than the usual blastocyst of cysticercoid larvae. The spherical or elongate gland cells with anteriorly directed ducts are closely massed together at the anterior end of the caudal appendage; they correspond to the " Frontaldrüsen " of *Tetrarhynchus scolecinus* Rud., described by Pintner. The ventral excretory stems of the two sides open into the large cylindrical vesicle in the form of a T, and the dorsal vessels also empty into it just behind the ventral ones. The excretory pore lies at the posterior end of the appendage. This worm evidently represents a distinct genus, for which the name *Pintneriella* is proposed. The generic diagnosis is reserved until the adult is known. The specimen, 25.2 mm long, from *Pagrosomus unicolor* is designated as genotype under the name of *Pintneriella musculicola*.

Tetrarhynchus scolecinus Rud., 1819, apparently belongs to this new genus. Pintner's statement that there are no typical microhooks in *T. scolecinus* seems to me very doubtful.

B. Cysticercoid larvae

1. *Floriceps* Cuvier. The larva of *F. elongatus* (Rud.) is very common in the liver of Japanese *Mola mola*. On its detailed anatomy the work of Cammerloher may be referred to.

2. *Lintoniella* n. g. Since the genus *Rhynchobothrius* Rud., 1819, is a heterogeneous group and its type has been suppressed by Vaullegeard as a doubtful species, this generic name should not be used any longer. For *Rhynchobothrium speciosum* Linton, 1897, characterized by the proboscis hooks, I propose a new genus *Lintoniella*. This species seems to be common on the

Atlantic coast of the United States, inasmuch as it occurs, according to Linton, in twelve species of Woods Hole fishes, three species of Beaufort fishes, five species of Bermuda fishes and four species of Tortugas fishes. A similar larva was found frequently in the fishes from the Inland Sea of Japan, as shown in the following table.

Hosts	Date
Epinephelus akaara	Aug. 27, 1931
Trachurus trachurus	Aug. 18, 1927
Sphyraena pinguis	Sept. 9, 1932
Tylosurus schismatorhynchus	July 27, 1929
Muraenesox cinereus	July 22, 1928
Pagrosomus unicolor	Jan. 12, 1928
Scomberomorus niphonius	Jan. 15, 1928
Seriola quinqueradiata	March 21, 1927
Paralichthys olivaceus	Oct. 17, 1927

The measurements in mm on alcoholic specimens are as follows: body 5.5–16.5 × 0.18–0.65; bothridia 0.62–1.0; pars vaginalis 1.9–5.6; muscular bulbs 0.63–1.16 × 0.09–0.27; pars postbulbosa 2.1–9.0 × 0.3–0.94.

The two, posteriorly emarginate, surficial bothridia bear long stiff hairs along their mobile edges. The proboscides are about 1.6 mm long and 0.045 mm broad at the base, but only 0.015 mm at the fully everted apex. There are fourteen longitudinal rows of hooks: three rows of strongly recurved, stout hooks on the medial side; a single row

Fig. 181 Fig. 180

Fig. 180-182. *Lintoniella speciosa* (Linton, 1897) from *Seriola quinqueradiata*. Fig. 180. Proboscis hooks on ventral side. Fig. 181. Same on dorsal side. Fig. 182. Smallest lateral hook.

of the smallest hooks with a very prominent guard on the lateral side; and five longitudinal rows on the dorsal and the ventral side. In the row next the smallest hooks mentioned above a larger anterior and a smaller posterior hook of different shapes lie tandem in twos. The pars vaginalis contains numerous large granular masses around the proboscis sheath. The proboscis retractor does not reach to the posterior end of the muscular bulb. The pars postbulbosa is, as a rule, sharply marked off by a constriction, and terminates posteriorly in a button-like process covered by a dense coat of hairs. The terminal shallow excretory vesicle with a wide opening to the exterior receives the dorsal and ventral excretory vessels at its anterolateral angles.

3. *Grillotia erinacea* (van Beneden, 1865) Guiart, 1927. The larva of this species was found in the body cavity of *Dasycottus setiger*, *Lotella physis* and *Gadus macrocephalus* from Toyama Bay. It is characterized by the arrangement of the proboscis hooks. As described by Vaullegeard there are two forms of proboscis hooks, of which the larger are arranged in eight longitudinal rows, the strongly recurved, stout ones being on the inner side and the comparatively slender ones on the outer. The slightly recurved, smaller hooks are set below the larger in somewhat irregularly oblique rows on the outer side of the proboscis. The proboscides are 0.06-0.07 mm broad but their total length could not be determined. The two, more or less flat, surficial bothridia, 0.81-0.93 mm long, are emarginate on the posterior border. The pars vaginalis is 1.5–1.77 × 0.8–1.0 mm. The retractor is attached to the posterior end of each muscular bulb measuring 0.75–1.42 × 0.16–0.3 mm. The pars postbulbosa, 2.1-2.1 × 0.68–0.85 mm, is fringed with hairs at the truncate posterior end, where the spacious excretory vesicle opens to the exterior.

4. Larva from shrimp. I have found in the liver of *Penaeopsis* spp. from the Inland Sea and Toyama Bay a very small cysticercoid larva which bears a certain resemblance to *Tetrarhynchus rubromaculatus* Dies., 1863.

The scolex, only 0.94–2.3 mm long, is enclosed in the inflated anterior part of the blastocyst, from which it can easily be liberated. The two, nearly circular surficial bothridia are 0.12–0.21 mm long, with their free posterior edges projecting outwards. The proboscides, about 0.42 × 0.015 mm when fully everted, bear each nine longitudinal rows of hooks, strongly recurved on the inner side and becoming less stout toward the outer side, where there is a narrow field of very small, delicate hooks extending throughout the length of the proboscis. The pars vaginalis, 0.24–0.96 × 0.15–0.23 mm, contains numerous large granular masses along the proboscis sheaths which have each a nodular swelling at the posterior end. The retractor is attached to the base of the muscular bulb. The latter measures 0.36–0.95 × 0.03–0.05 mm. The pars postbulbosa, 0.25–0.33 mm long, stains deeply with hematoxylin in its anterior part, and its posterior end is fringed with hairs. The large terminal excretory vesicle receives the dorsal and ventral excretory vessels at its anterolateral angles.

The anterior part of the blastocyst is swollen into a vesicle 0.7 mm in diameter and containing numerous corpuscles, which are entirely lacking in the tail-like posterior portion. The excretory vesicle formed by the union of two

Fig. 184

Fig. 183

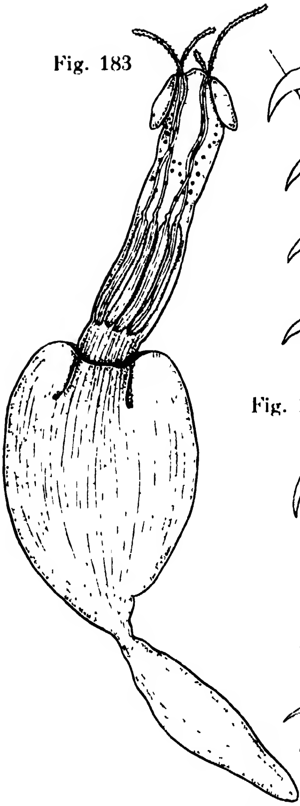

Fig. 185

Fig. 186

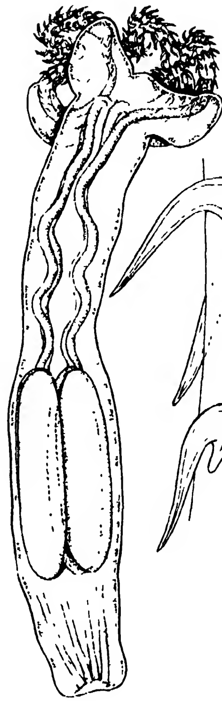

Fig. 187

Fig. 183–185. Cysticercoid from *Penaeopsis* sp.
Fig. 183. Entire worm, with its scolex pressed out of blastocyst.
Fig. 184. Proboscis hooks on inner side.
Fig. 185. Same on outer side.

Fig. 186. Larva of *Pterobothrium* sp. from intestinal content of *Inimicus japonicus*. 2.6 mm long.
Fig. 187. Proboscis hooks of same.

main lateral vessels opens at the posterior end of the body. The longitudinal muscle fibers are greatly developed in all parts.

5. *Pterobothrium* Dies., 1850. A larva of this genus was found in the intestinal contents of *Inimicus japonicus* from Toyama Bay. The body is about 2.6 mm long. The crosswise disposed bothridia are recurved forwards as in other members of the genus. The proboscis, everted at the distal end of each bothridium, is about 0.6 mm long by 0.05 mm broad. The more or less slender, long hooks form about ten longitudinal rows, those of the inner side being the larger. There are, in addition, several small hooks on the outer side of the proboscis just behind the larger ones. The pars vaginalis is 1.0×0.37 mm. The muscular bulbs, 0.95×0.2 mm, extend a little into the deeply stained pars postbulbosa. The latter, 0.44×0.41 mm, is truncated at the end, where the wide aperture, about 0.2 mm broad, of the shallow excretory vesicle is found.

From the above description it is certain that this larva does not belong to any known species of *Pterobothrium*; the descriptions of *P. macroura* Rud., *P. crassicolle* Dies., *P. heteracantha* Dies. and *P. interruptum* Rud., are too meager to enable one to institute any comparison.

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Abbreviations used in Figures

Acc. s. accessory sucker
Atr. genital atrium
Cirr. cirrus
Cist. cistern
Coag. coagulum in proboscis
C. p. cirrus pouch
D. ej. ductus ejaculatorius
D. herm. ductus hermaphroditicus
D. sem. ductus seminalis
D. v. dorsal excretory vessel
D. v. m. dorsoventral muscle
Ex. excretory stem
Ex. v. excretory vesicle
G. d. germiduct
G. p. genital pore
Inn. m. inner longitudinal muscle
Inv. inverted portion of proboscis
Lig. ligament
M. muscle
N. nerve trunk
Ooc. oocapt
Ov. ovary
Pr. c. prostatic cells
P. bord. posterior border of proglottis
Rec. cirr. receptaculum cirri
Retr. retractor
R. s. receptaculum seminis
Sh. gl. shell gland
Sph. sphincter
Test. testis
Tr. m. transverse muscles
Ut. d. uterine duct
Ut. p. uterine pore
Ut. s. uterine sac
Vag. vagina
Vag. p. vaginal pore
V. def. vas deferens
Vit. vitellaria
Vit. d. vitelline duct
Vit. res. vitelline reservoir
V. sem. vesicula seminalis
V. s. ext. vesicula seminalis externa
V. s. int. vesicula seminalis interna
V. v. ventral excretory vessel

2. Observations on Gnathostoma spinigerum Owen 1836, Cause of Esophageal Tumor in the Japanese Mink (Lutreola itatsi itatsi (Temminck 1844)), with Especial Reference to its Life History

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Since Owen first described this worm from the gastric tumor of a young tiger which died in the London Zoological Gardens, there have been about a dozen reports on the adult from the dog, wild and domesticated cats, leopard, pig, weasel and even rat and on the larval form in man from various countries but especially from India, Siam, Malay States, Philippines, China and Japan. Partly owing to the scantiness or bad preservation of the materials, previous descriptions are very incomplete and even so contradictory that the worm has been placed in different species or genera. Baylis and Lane have well summarized these descriptions and revised the specific diagnosis.

In 1924 I and my assistant S. Hamada accidentally found the worm in the esophageal tumor of a Japanese mink brought to our laboratory, and I have examined over 3550 minks during the past ten years with especial attention to this parasite. In 1925, I made my first report to the 6th Congress of the Far Eastern Association of Tropical Medicine held in Tokyo, Japan. The following April (1926) I gave more detailed observations at the 6th Annual Scientific Session of the Japanese Pathological Association held in Tokyo, and in 1930 I published further results of my experiments and observations in the Japanese medical periodical "Nisshin Igaku", Vol. 20, No. 10. In April 1933 I reported the results of my experiments on the life history of this worm at the general meeting of the Japanese Parasitological Association held in Fukuoka. In this paper I propose to give a summary of my observations on *Gnath. spinigerum* during the last ten years, with especial reference to the experiments carried out to elucidate its life history.

MATERIALS

The Japanese mink is protected by law and as the closed season is spring-autumn, materials can be obtained only in winter. For the first two or three years I depended on materials voluntarily offered by friends or others who occasionally captured the animal, but since about 1927, they were supplied from the vicinity of Osaka by a furrier, so that enough material was at my disposal. Table 1 gives the number of animals examined and the percentage of infection.

It appears that over 50% of the animals are infected.

Table 1

Years	Total numb. of animals examined	Number and % of ♂	Number and % of ♀	Number and % of infection	Number and % of infection in ♂	Number and % of infection in ♀
1924–1926	23	16 60.56%	7 30.43%	12 52.17%	12 75.00%	
1926–1927	126	101 80.16%	25 19.84%	76 60.31%	70 69.31%	6 24.00%
1927–1928	304	234 76.97%	70 23.02%	234 76.97%	187 79.91%	47 67.14%
1928–1929	324	270 83.33%	54 16.65%	203 62.65%	179 66.29%	24 44.44%
1929–1930	423	386 91.25%	37 8.74%	230 54.37%	204 52.85%	26 70.27%
1930–1931	505	448 88.71%	57 11.29%	231 45.74%	208 46.42%	23 40.35%
1931–1932	730	613 83.97%	117 16.03%	362 49.59%	316 51.55%	46 39.32%
1932–1933	1115	751 67.35%	364 32.65%	485 43.41%	357 47.40%	128 35.16%
Total	3550	2819 79.41%	731 20.59%	1833 51.63%	1533 54.38%	300 41.04%

Tumor

Previous reports of this parasite are, with one exception, all from the gastric wall of such carnivores as the tiger, leopard, cat, dog, mink etc., and the exception, in which the worm was found free in the intestine of a rat, is doubtful. In my own materials, it is without exception the esophageal wall which is invaded and forms the tumor in the lower part lying in the thoracic cavity, usually only one in a single host but rarely separated into the upper and the lower, and irregular and various in shape and size. The tumor begins as a mere thickening of the esophageal wall, which later presents swellings both on the inside and outside. Subsequently the esophageal wall gradually swells on the outside and the tumor ultimately assumes various forms and are of different sizes. Owing to the irregularity of form, the size of a tumor can not be expressed precisely by its length and breadth. It may grow to the enormous size of 20 or 30 mm in length as well as in breadth. Whatever its size may be, it occupies only one side of the esophageal wall and never extends all round. The inner surface of the tumor usually presents perforations varying in size and number according to the size of the tumor.

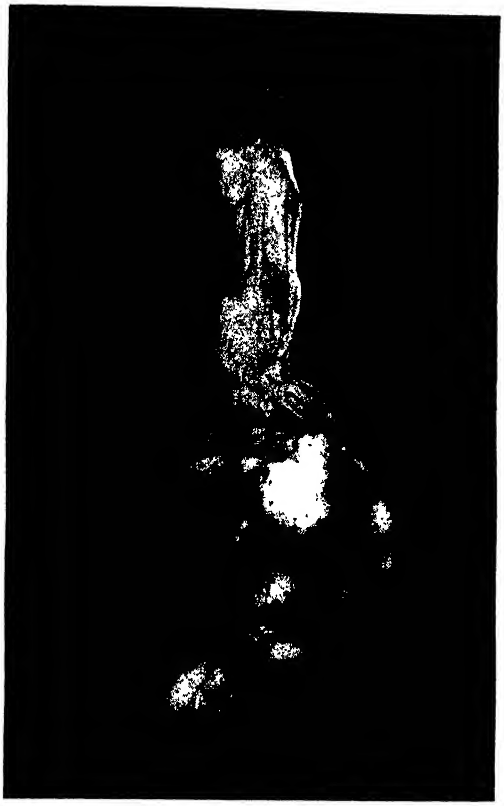

Fig. 1. Outer view of tumor.

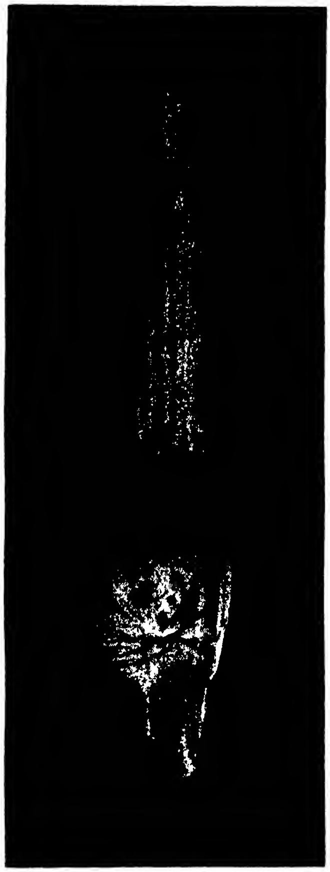

Fig. 2. Inner view of tumor.

A number of worms, usually less than ten but varying from one to thirty or more, have their heads inserted into the tumor through the perforations, with the tail end hanging free in the esophageal lumen. In fresh materials, the worms can be easily pulled out without suffering any injury. It is rare that the heads or tails of the worms are protruded on the outer surface of the esophagus. Table 2 shows the number of minks parasitized by different numbers of worms in one tumor; it is the result of my observations during the first six years of this work.

Table 2

Years	Total	No worm	1-9 worms	10-19 w.	20-29 w.	30- w.
1924-28	322	18	221	66	14	3
1928-30	433	8	377	39	7	2
Total	755	26	598	105	21	5

Fig. 3. Inner view of a large tumor.

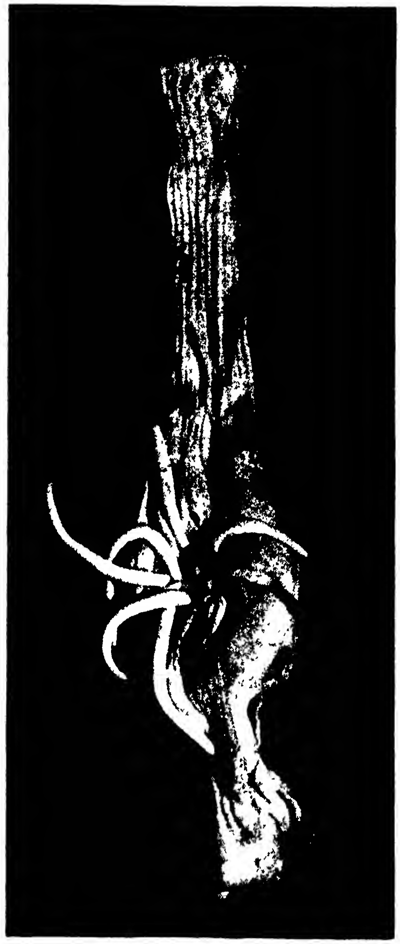

Fig. 4 Worms in natural position.

On the average there are 5 or more worms in a single tumor.

Pathogenicity

In previous reports of *Gnath. spinigerum* from the gastric tumor, death of the host ensues when the tumor comes into communication with the body cavity through a perforation. This may be the reason why the parasite was so rarely found for about a century after Owen's first finding, and its morphology and development could not be studied sufficiently. Fortunately, all the materials which have come into my hand have no perforation on the outer side of the tumor, considerably reducing the fatal cases, so that the infection amounts to more than 50% in the Japanese mink.

The esophageal tumor of tolerable size almost always contains calcareous concrements.

Development

Egg. The uterine or newly laid eggs are in the one- or two-celled stage and are nearly oval, with a knob at one pole. The egg shell is transparent and colorless and has minute granules on the outer surface; it is 0.063–

Fig. 5. Calcareous deposits.

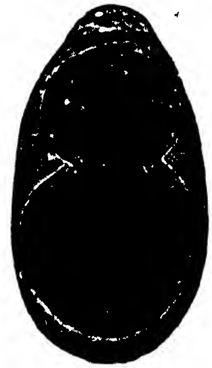

Fig. 6 Two-celled egg.

0.076 mm long and 0.036–0.048 mm broad.

Embryonal Development. We have no reliable knowledge of the embryonal development of this parasite and the details of its postembryonal development is wholly unknown, though a few suggestions have been attempted.

For observations on the embryonal development, I cultivated the uterine eggs in water. The first cultivation was started on April 18, 1925, and its result was reported in a previous paper. Since then I have always used the same method to obtain embryos for use in my study of the postembryonal development, undertaken since 1924.

The eggs were placed in water in a shallow dish at room temperature in summer and in the incubator at 27°–34°C in other seasons. The first cleavage divides the egg into 2 blastomeres of unequal size, and the whole embryonal development is completed at the temperature of 27°–31°C in a week. The motile embryo leaves the egg shell after two days or more and actively swims in the medium, so that the interval between egg laying and hatching is comparatively short, although it depends much upon temperature and the maturity of the egg. The eggs removed from the same uterus are in different stages of maturity, so hatching continues for over ten days even under the same external conditions. The matured embryo within the egg shell is surrounded by a very thin membrane; and hatching usually takes place through the knob.

The newly hatched, actively motile embryo is ensheathed in a thin delicate membrane, and measures 0.223-0.275 mm in length and 0.0134–0.0174 mm in breadth. The rounded anterior end has a spine-like armature, while the posterior part of the body gradually tapers towards the pointed caudal end.

In water, the liberated embryos seem to survive usually for a few days, but sometimes they may live in summer for a month or twice as long at room temperature.

Fig. 7. Embryonated egg.

Fig. 8. Newly hatched embryos.

Postembryonal Development. For elucidating the postembryonal development, I fed two white rats with living free embryos on April 28, 1925; the result was negative, as in the numerous experiments carried out subsequently, so that I was led to think that intermediate host of some kind or other was necessary to complete the life cycle.

As a first step towards the finding of the intermediate host, I examined the contents of the alimentary canal of the final host and studied its ecology. In the alimentary canal were found fragments of various insects, frog skin and bones, and scales and bones of fishes and reptiles; so I made some infection experiments with liberated embryos on the gold-fish and green frog.

In the winter of 1926, I kept gold-fishes with great numbers of motile embryos just hatched, and fed the frogs with the embryos or injected them into the dorsal subcutaneous lymph sac. All were without desired results.

In winter, the artificially hatched embryos must be placed continuously at

a tolerably high temperature to insure life, but fishes and frogs can not live long under such a condition, so that experiments for the intermediate host are difficult to carry out in winter. Therefore I kept the uterine eggs obtained during the winter in an ice chamber in order to inhibit their development until next spring or the beginning of summer.

Since the summer of 1932, I directed my attention as possible intermediate host to small crustacean freshwater plankton and have examined numbers of copepods, phyllopods, ostracods, cladocerans etc. I found that cyclops could be kept alive longer than others in the dish; so they were kept with newly hatched gnathostome embryos in petri dishes, and subjected to microscopical examination one after another. In October, a few of the cyclops were found to contain

Fig. 9. Embryos in cyclop.

nematode larvae which I thought belonged to another nematode species or were accidental invaders from the beginning. Afterwards I made my experiments with cyclops and gnathostome embryos more precise, and in every experiment, the cyclops were found infected by the gnathostome embryos. Several more experiments confirmed that the newly hatched embryos easily entered the cyclops and continued to live in them. Numerous experiments continued until the summer of 1933 proved beyond doubt that the cyclops are the intermediate host of *Gnathostoma spinigerum* Owen.

The results of my experiments may be summarized as follows.

If newly hatched embryos are put in a shallow dish containing numerous cyclops, almost all of them are found in the alimentary canal of the cyclops on the next day, and two or three days later actively moving larvae can be

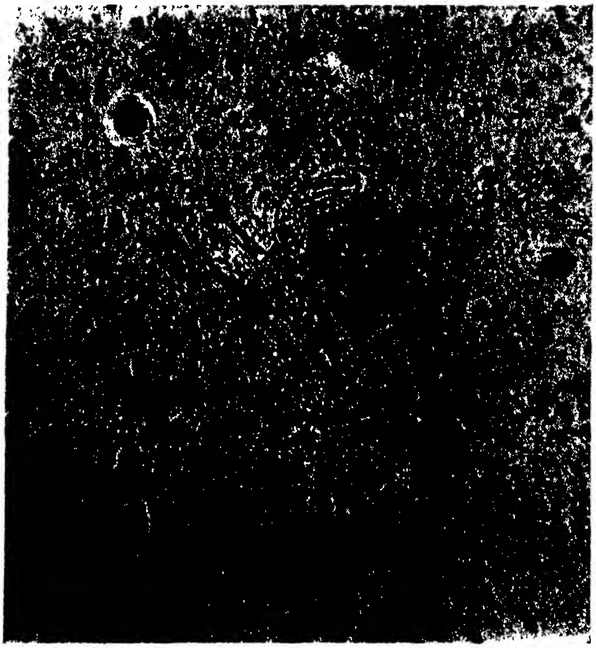

Fig. 10. Infected cyclop.

observed in the body cavity of the host, in which they grow and reach a definite stage of development. The larvae in the control dishes with no cyclops in them, die in the course of some days. The larvae in the body cavity grow to a fair size, when the characteristic head bulb appears. Larvae of 9 days in the cyclops are entirely destitute of spines.

Further Course of Development

To study the further course of development, I made several experiments with infected cyclops in the first place on the gold-fish, which I regarded as a possible final intermediate host; but examination of the gold-fishes at intervals between the 10th and 20th day gave negative results in all cases.

I next fed, on June 19, 26, and July 3, a young cat with the infected cyclops which were kept together with gnathostome larvae for three to nine days. The cat died on July 31, 43 days from the first and 28 from the last feeding, when I was absent. The postmortem performed by my assistant did not bring to light any visible trace of the parasite in the alimentary tract. Consonant to my previous advice the alimentary tract, liver, heart, pancreas

and lungs were preserved for future microscopical examinations. Macroscopically the lungs showed severe inflammations here and there on the surface. Further examination of this cat is in progress, as well as other feeding experiments with infected cyclops.

There are two possible courses in the further development of this parasite, 1) the larvae in cyclops may be directly introduced into the final host, or 2) the larvae in cyclops need a second intermediate host. I am going to undertake experiments to settle this question. And I may here refer to Chandler's paper which seems to me very suggestive. He found numerous cysts of gnathostome larvae in the mesentery of various snakes in India, and young cats fed with these encysted larvae were found on examination to habor in the liver many larvae quite resembling *Gn. spinigerum.* It is probable that the larvae encysted in the snakes were those of *G. spinigerum*, as Chandler supposed. Chandler thought, however, that the source of infection in the snake is devouring of the eggs contained in the intestinal contents, in the verminous tumor, or in the worms themselves, still inside the definitive host. This is an erroneous supposition based on the statement of Baylis and Lane that the uterine eggs are embryonated, which is not the case, as before mentioned. The uterine eggs or those in the feces or in the mother worms are not infective, until motile embryos are hatched out. On the basis of my own observations, I am of opinion that the Indian snakes became infected by the gnathostome larvae by swallowing infected cyclops. August 1933.

Postscript

After the completion of this manuscript, I received the preliminary report on the life cycle of *Gnathostoma spinigerum* by Chalern Prommas and Svasti Daengsvang, who also found by experiments that cyclops can be infected with gnathostome embryos and observed in cyclops larvae more advanced than those observed by me.

Experiments continued since this spring have shown that the gnathostome larvae develop further in cyclops, the head bulb becoming covered with rings of hooks and the anterior part of the body also with similar rows of minute hooks. August 1934.

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3. Polyclad Turbellarians from the Neighborhood of the Mitsui Institute of Marine Biology

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With Plate I

The polyclad turbellarians dealt with here were collected by me in 1932 and 1933 in the neighborhood of the Mitsui Institute of Marine Biology at Susaki near Shimoda, Shizuoka Prefecture. Of the 16 species listed below, 6 appear to be new.

Order Polycladida
- Suborder Acotylea
  - A. Section Craspedommata
    - Family Stylochidae
      1. *Stylochus ijimai* Yeri et Kaburaki
  - B. Section Schematommata
    - Family Leptoplanidae
      2. *Notoplana delicata* Yeri et Kaburaki
      3. *Notoplana humilis* (Stimpson)
      4. *Stylochoplana pusilla* Bock
      5. *Susakia badiomaculata* gen. et sp. nov.
    - Family Planoceridae
      6. *Planocera reticulata* (Stimpson)
    - Family Displosolenidae
      7. *Callioplana marginata* Stimpson
      8. *Pseudostylochus fuscoviridis* sp. nov.
      9. *Pseudostylochus obscurus* (Stimpson)
- Suborder Cotylea
  - Family Pseudoceridae
    10. *Pseudoceros atropurpureus* sp. nov.
    11. *Pseudoceros micropapillosus* sp. nov.
    12. *Pseudoceros susakiensis* sp. nov.
    13. *Pseudoceros reticulatus* Yeri et Kaburaki
    14. *Thysanozoon brocchii* (Grube)
  - Family Euryleptidae
    15. *Cycloporus variegatus* sp. nov.
  - Family Prosthiostomidae
    16. *Prosthiostomum grande* Stimpson

There have been found some six more species, one of which is referable to *Paraplanocera* and appears to be closely related to *P. misakiensis*, *P. discus*

and *P. marginata*, but since a more careful comparison of it with the first of these three species is needed, it is left out for the present. The other species, judging from their coloration and the arrangement of eye-spots, appear to be new, but are not included in this paper, because their reproductive organs were unfortunately not yet developed.

Before proceeding further, I would like to express my hearty thanks to Professor T. Kaburaki for his valuable help and advice.

1. *Stylochus ijimai* Yeri et Kaburaki

Stylochus ijimai, Yeri et Kaburaki, 1918 p. 6–8.

This species is rather common on the Pacific coasts of Japan in spring and summer. Often it attacks young oysters.

Localities. Misaki, Enoura, Susaki.

2. *Notoplana delicata* Yeri et Kaburaki

Notoplana delicata, Yeri et Kaburaki, 1918, p. 13–15.

This species is fairly common in the neighborhood of the Institute throughout the year.

Localities. Shirahama in Prov. Awa, Misaki, Susaki.

3. *Notoplana humilis* (Stimpson)

Leptoplana humilis, Stimpson, 1857, p. 4, 9; Diesing, 1862, p. 533; Lang, 1884, p. 496.
Notoplana humilis (Stimpson), Yeri et Kaburaki, 1918, p. 11–13; Yeri et Kaburaki, 1923, p. 191–192.

This is one of the commonest species on the Pacific coasts of Japan and is found throughout the year. The color of its body is very variable but generally gray, brown or black.

Localities. Misaki, Oshoro, Otaru, Shirahama in Prov. Awa, Susaki.

4. *Stylochoplana pusilla* Bock

Stylochoplana pusilla, Bock, 1924, p. 1–24.

In the mantle cavity of *Monodonta labis* Linné, a common sea snail occurring between tide-marks, was found a planarian identical with Bock's *Stylochoplana pusilla* from the corallina-formation in front of the Misaki Marine Biological Station. In its external features and mode of life, it presents some resemblances to *Hoploplana inquilina* (Wheeler) from *Sycotypus canaliculatus* Gill in the Woods Hole region. Generally 1–5 young and full-grown planarians are found in one snail and the frequency of infestation is about 50% in autumn and 10% in spring. Rarely other gastropods such as *Tegula exanthostigma* (A. Adams) and *Thais tumulosa clavigera* (Küster) serve as hosts, but whether or not the planarian draws nutriment from the host is not certain.

Generally it is found creeping about near the gill of the host. Since its eggs have never been found in the mantle cavity at any time of the year, spawning must take place outside, and the hatched larvae find their way into the mantle cavity of the snail. To my mind, it appears that Bock's specimens were those which had left the host.

In life, the body is of a moderately firm consistency, oval and fairly convex on the dorsal side. Large full-grown specimens measure 4 mm long by 2 mm broad at the widest part.

The color is light brown on the dorsal side, darker along the intestine, and much paler on the ventral side.

The tentacles are very small and bluntly pointed at the apex. The 10–20 tentacular eye-spots form a round cluster at the base of the tentacle. The cerebral eye-spots are found around the brain region on the sides.

On the internal structure only some remarks will be given here. Bock says that the genital aperture is single, but a close examination shows that there are two genital apertures slightly apart from each other. Another peculiarity concerns the uteri. The common uterine duct divides into two uteri, which run downwards for a short distance and then divide again into two ducts; the outer duct proceeds forwards to near the hind end of the pharynx, while the inner runs forwards alongside the pharyngeal sheath to the brain region.

5. *Susakia badiomaculata* gen. et sp. nov.

Pl. I, fig. 4; text figs. 1, 2

A single example of this interesting species was obtained between tide-marks in the autumn of 1932.

In life, the body is flexible and of an elongate oval shape, with the anterior end a little broader than the posterior, and measures 30 mm long by 10 mm broad at the brain region. On the dorsal side the ground color is milky white with a faint tinge of brown and blotched all over with irregular chocolate-brown specks of various sizes. A slender median band of the same color extends from behind the eye-spots to the end of the middle third of the body. The ventral side is milky white.

Text fig. 1. *Susakia badiomaculata*; eye-spots ×50.

There is no tentacle. The tentacular eye-spots form two round, crowded clusters at a distance of about one-eighth the body length from the anterior end. The cerebral eye-spots are scattered on either side of the median line but chiefly in front of the tentacular eye-spots. No marginal eye-spots.

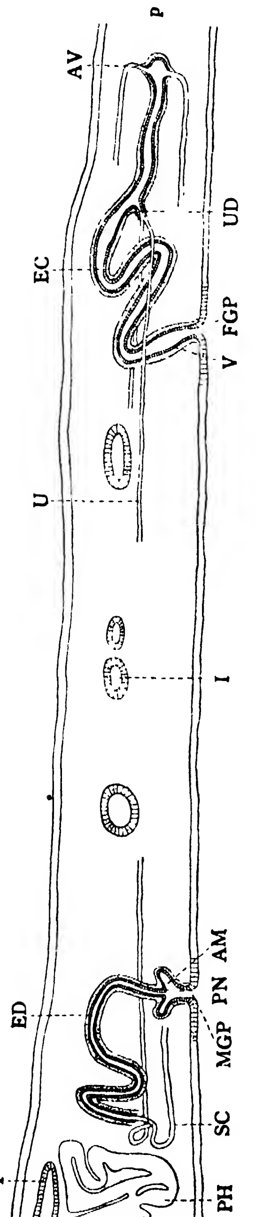
The epidermis is much higher on the dorsal than on the ventral side and

contains numerous, highly eosinophilic glandular cells, whose secretion covers the whole dorsal surface so thickly that no cilia can be demonstrated on it. Just beneath the thick basement membrane lies the musculature of the body wall, which is unusually thick and is better developed on the ventral than on the dorsal side; on the dorsal side it consists of the outer longitudinal and the inner circular layer, but on the ventral side it has an additional thick layer of inner longitudinal fibers. The dorsoventral muscular bundles are so well developed as to render the parenchyma insignificant. This unusually good development of the muscles may be related to the life of the worm among breakers.

The mouth is at the center of the body and leads into the pharyngeal chamber containing the plicated pharynx.

The testes are more ventral than dorsal in position. The seminal canal proceeds forwards on each side, from the posterior part of the body to near the pharynx and turning mediad, the two unite into a narrow muscular ejaculatory duct, which after an M-like tortuous course, makes its way to the tip of the small conical penis lying vertically in the penis sheath. The latter opens through the short tubular antrum masculinum. There are no organs corresponding to the seminal vesicle or prostate gland.

The female genital aperture lies far from the male. The vagina, after a short obliquely forward and upward course, passes into the winding muscular egg-canal, which after receiving the common uterine duct on the ventral side, runs backwards to near the posterior body end and there passes over into a small spherical accessory vesicle. This vesicle sends out on each side a slender canal, which extends forwards to near the level of the hind end of the pharynx. The common uterine duct soon divides into two uteri extending to the anterior part of the body. The shell glands appear to be rudi-



Text fig. 2. *Susakia badiomaculata*; reproductive organs in sagittal section, diagrammatic. ×50.
a anterior; AF antrum feminimum; AM antrum masculinum; AV accessory vesicle; EC egg-canal; ED ejaculatory duct; FGP female genital pore; I intestine; MGP male genital pore; p posterior; PH pharynx; PN penis; SC seminal canal; U uterus; UD unpaired uterine duct; V vagina.

mentary and without any eosinophilic secretion.

This new genus is closely related to *Discoplana* in many external and internal features, but can be distinguished from it chiefly by the presence of slender canals sent out from the accessory vesicle.

6. *Planocera reticulata* (Stimpson)

Stylochus reticulata, Stimpson, 1855, p. 381; Diesing, 1862, p. 569.
Stylochoplana reticulata, Stimpson, 1857, p. 4, 11.
Planocera reticulata, Lang, 1884, p. 445.
Planocera reticulata (Stimpson), Yeri et Kaburaki, 1918, p. 19–22.

This species is found in abundance in this district and Misaki all the year round; multi-tentacular forms often occur.

Localities. Loo-choo, Misaki, Susaki.

7. *Callioplana marginata* Stimpson

Callioplana marginata, Stimpson, 1857, p. 4, 11; Yeri et Kaburaki, 1918, p. 32–34.
Stylochus marginatus, Diesing, 1862, p. 569; Meixner, 1907, p. 103.
Planocera (?) *marginata*, Lang, 1884, p. 445.

Fairly common in summer.

Localities. Misaki, Sunosaki, Susaki.

8. *Pseudostylochus fuscoviridis* sp. nov.

Pl. I, fig. 2; text figs. 3, 4

This planarian was found in summer together with *Pseudostylochus obscurus* on the underside of stones in the tidal zone.

In life, the body is elongate-oval, the anterior end being a little broader than the posterior. A large specimen measures 26 mm long by 17 mm broad at the widest part. The dorsal side is grayish green, with a darker median stripe and very faintly colored margins, and scattered all over are numerous irregular brown and darkish green specks. The ventral side is milky white.

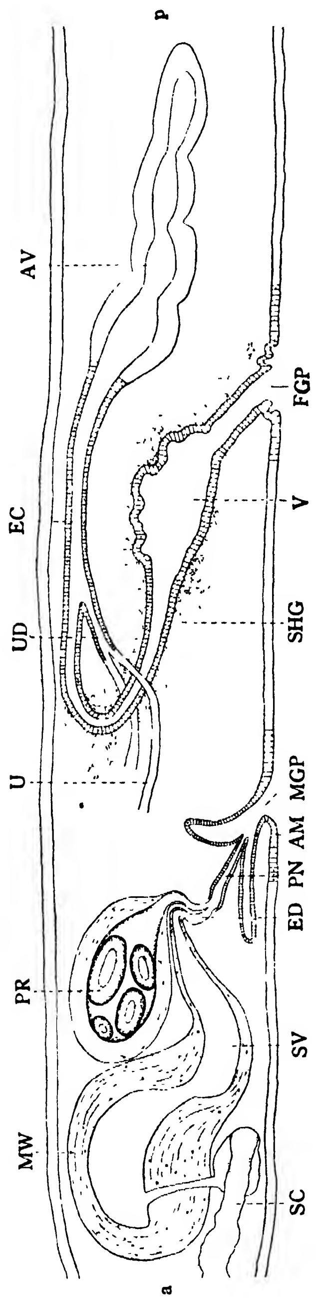
A pair of very small, slender tentacles are present in the living state. The tentacular eye-spots form a compact cluster at the base of each tentacle. The cerebral eye-spots occur in two clusters over the brain region. No marginal eye-spots.

Text fig. 3. *Pseudostylochus fuscoviridis*; eye-spots. $\times 30$.

The mouth lies near the center of the body.

The numerous round testes lie in the ventral half of the body. The

seminal canal runs backwards to just beneath the large, very muscular seminal vesicle and unites in the median line with its fellow of the opposite side to form a small vesicle. Dorsally this vesicle gives rise to a narrow canal which passes upward into a large, very muscular seminal vesicle with the lumen slightly constricted near the middle. Posteriorly the seminal vesicle gives rise to a narrow ejaculatory duct, which after a somewhat S-like course opens at the apex of the penis, after receiving the duct from the prostate. The small conical penis lies subvertically in the antrum masculinum.



Text fig. 4. *Pseudostylochus fuscoviridis*; reproductive organs in sagittal section, diagrammatic ×50. MW muscular wall; PR prostate; SHG shell gland; SV seminal vesicle; other letters as in text fig 2.

The large accessory vesicle with irregular constrictions gives rise in front to the egg-canal, which extends forwards for a long distance through a mass of unicellular shell glands and then bends abruptly downwards and backwards to continue into the vagina. The female genital aperture lies far from the male. Slightly posterior to its turning point, the egg-canal receives a common uterine duct formed by the union of the two uteri, which run forwards alongside the pharyngeal sheath. The ovaries are distributed in the dorsal half of the body.

This species closely resembles *P. obscurus*, but may be distinguished from it by the difference in color markings as well as by the peculiarity in the reproductive system, especially in the seminal vesicle.

9. *Pseudostylochus obscurus* (Stimpson)

Stylochus obscurus, Stimpson, 1857, p. 4, 11; Diesing, 1862, p. 566; Lang, 1884, p. 464.
Pseudostylochus obscurus, Yeri et Kaburaki, 1918, p. 30–31; Yeri et Kaburaki, 1923, p. 193–196.

This species is very common in this district all the year round, and appears to be of fairly wide distribution in Japan.

Localities. Mera in Prov. Awa, Misaki, Oshoro, Otaru, Susaki.

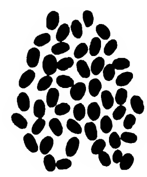
10. *Pseudoceros atropurpureus* sp. nov.

Pl I, fig. 3; text figs. 5, 6

A single specimen of this new species was obtained near low tide-mark on May 13, 1933.

In the living state the body is thick, broad and leaf-like with somewhat frilled margin, and measures 40 mm long by 15 mm broad at the widest part. The dorsal side is dark purplish, darker towards the median part and with numerous minute white dots all over. The ventral surface is paler. The cerebral eye-spots form a single cluster in an oval clear space at the base of the tentacular flaps, which have a number of minute scattered eye-spots.

The epidermis is higher on the dorsal than on the ventral side and as usual, the rhabdites are more numerous on the former than on the latter. Moreover, a large amount of minute dark pigments is contained in the dorsal epidermal cells.

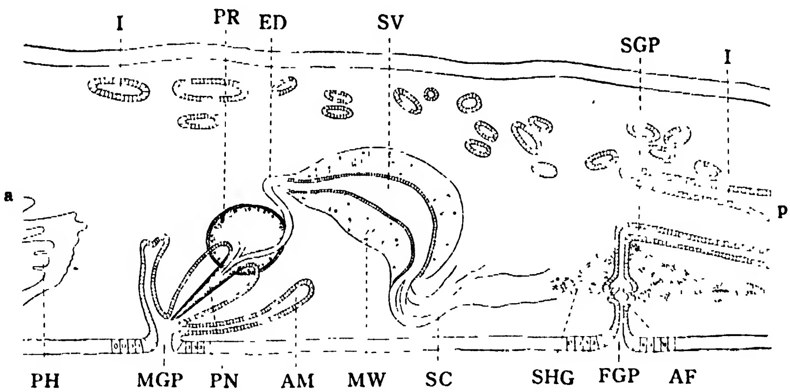


Text fig. 5. *Pseudoceros atropurpureus*; eye-spots. ×100

A sucker is present at the center of the body.

The mouth lies closely behind the brain. The intestinal branches form an anastomosing system.

The testes lie in the ventral half of the body. The seminal canals, one on each side, proceed forwards and turning slightly downwards near the seminal vesicle open into it side by side, describing a curve. In front of its opening



Text fig. 6. *Pseudoceros atropurpureus*; reproductive organs in sagittal section, diagrammatic. ×50. SGP shell gland passage; other letters as in text figs. 2, 4

into the vesicle, the seminal canal of the left side forms a loop, probably owing to longitudinal splitting. Whether this peculiarity is normal or teratological is uncertain for lack of material. The comparatively large seminal vesicle is very muscular and continues anteriorly into the slender ejaculatory duct, which pursues a somewhat S-like course on the left side of the prostate and, after

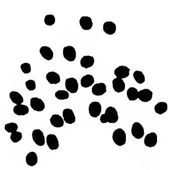
receiving from it a short duct, opens at the apex of the penis, a horny stylet lying subvertically in the penis sheath. The spherical prostate lies dextro-dorsal to the base of the penis. The hemispherical antrum masculinum forms an oblique upwardly directed, annular outbulging, and opens externally in the median line about midway between the ventral sucker and the frontal end of the body. The female genital aperture lies a little behind the male. The female reproductive organs are on the same plan as in other species of this genus.

11. *Pseudoceros micropapillosus* sp. nov.

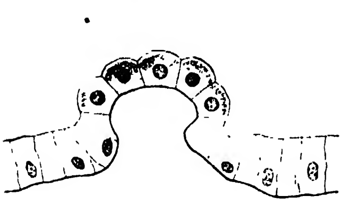
Pl. I, fig. 1; text figs. 7–9

This species is very common between tide-marks in spring.

In the living state, the body is elongate oval, 20–25 mm long by 9–13 mm at the broadest part, and of moderately firm texture. The dorsal side of deep vermillion color is covered all over with papillae scarcely visible to the naked eye, and with minute white dots in addition to some irregular white spots. The maginal tentacles are colorless at the apex. The ventral side is milky white with faintly colored margin. The pharynx and reproductive system can be seen only imperfectly.



Text fig. 7. *Pseudoceros micropapillosus*; eye-spots. ×70.



Text fig. 8. *Pseudoceros micropapillosus*; dorsal papilla in sagittal section. ×500.

The marginal tentacles are represented by folded flaps of the anterior body-margin, which bear numerous eye-spots both dorsally and ventrally. The cerebral eye-spots form a cluster in a clear space slightly behind the tentacles.

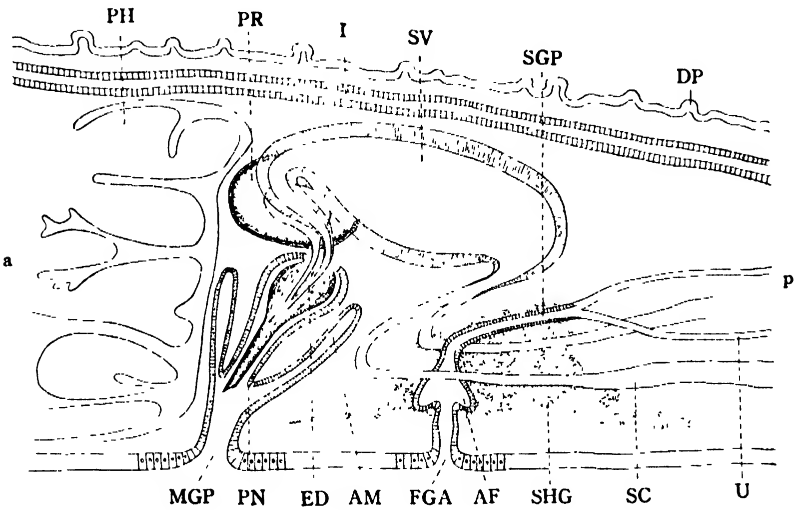
The sucker is a small cup-like disc situated at the center of the ventral surface.

The mouth lies behind the brain. The intestinal branches form an anastomosing system.

The epidermis of the ventral side is composed of high, regularly arranged, ciliated cuboidal cells and contains, as usual, numerous minute rhabdites; that of the dorsal side is lower and the cells are somewhat irregularly arranged and wholly destitute of rhabdites. The dorsal epidermis is raised here and there into the dorsal papillae, into which the underlying tissue also enters. Their epidermal cells are strongly eosinophilic and contain each a large nucleus at the center and some granular substances near the free surface, indicating that the papillae are glandular and not sensory.

The testes lie in the ventral half of the body. The seminal canals, one on each side, extend forwards to near the penis and turning abruptly upwards and backwards, unite into a single duct which soon passes from the ventral

side into the large muscular seminal vesicle filled with spermatozoa. From its frontal aspect the vesicle gives rise to a slender ejaculatory duct, which pursues a somewhat S-like course on the right side of the prostate and enters the muscular bulbous part of the penis. After receiving the duct of the prostate,



Text fig. 9. *Pseudoceros micropapillosus;* reproductive organs in sagittal section, diagrammatic. ×70. DP dorsal papilla; other letters as in text figs. 2, 4 and 6.

the ejaculatory duct makes its way to the tip of the horny stylet of the penis, which lies subvertically in the penis sheath. The pyriform prostate lies just dorsal to the penis and has a thin muscular wall. The antrum masculinum forms an oblique, upwardly directed, annular outbulging before it opens externally. The median external aperture lies close behind the pharyngeal chamber.

The ovaries lie dorsally. The two uteri open in the median line into the shell-gland passage, which proceeds obliquely ventral and expands into the antrum before opening outside behind the male aperture.

12. *Pseudoceros susakiensis* sp. nov.

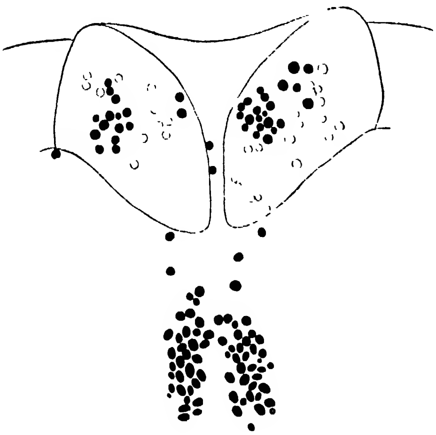
Pl. I. fig. 6; text figs. 10, 11

This new species is based on two examples obtained between tide-marks in May, 1933.

In life the body is elongate oval, broadly rounded at the two ends, and measures 12 mm long by 6 mm broad at the widest part. The ground color of the dorsal side is orange, with minute yellowish brown spots sparingly scattered all over; the lateral border, a median band and the frontal part near

the marginal tentacles are almost colorless; a pair of dark brown crescentic patches at the level of the cerebral eye-spots. The ventral surface is much paler.

Numerous eye-spots are distributed on both the dorsal and ventral sides of the short and narrow tentacular flaps of the frontal margin. Dorsal to the brain are numerous cerebral eye-spots in two closely approximated clusters. Scattered between the cerebral eye-spots and the tentacular flaps are some more eye-spots.

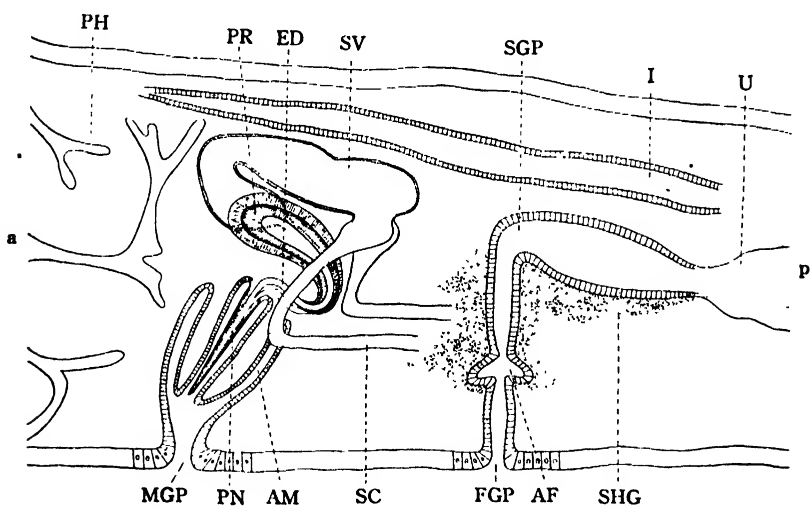


Text fig. 10. *Pseudoceros susakiensis*; eye-spots. ×50.

A sucker is situated near the center of the body.

The mouth lies a little behind the brain. The intestinal branches form an anastomosing system.

The seminal canals, full of spermatozoa, proceed forwards to near the level of the penis, where they turn abruptly upwards and backwards to open side by side into the seminal vesicle, which is a wide, anteriorly directed canal with thin muscular wall, and after an abrupt downward and backward turn at its anterior part continues into the ejaculatory duct. This pursues a tortuous course and after receiving the duct of the prostate at the base of the penis, opens at the tip of the latter.



Text fig. 11. *Pseudoceros susakiensis*; reproductive organs in sagittal section, diagrammatic. ×100. Index letters as in text figs. 2, 4 and 6

The small pyriform prostate lies beneath the seminal vesicle. The penis is chitinous, styliform, and lies subvertically in the penis sheath. The antrum masculinum forms an oblique dorsally directed, annular outbulging and opens externally behind the pharyngeal chamber.

The female aperture is closely behind the male; the arrangement of the female organs are closely similar to that found in other species of this genus.

13. *Pseudoceros reticulatus* Yeri et Kaburaki

Pseudoceros reticulatus, Yeri et Kaburaki, 1918, p. 35–36.

This species is common in summer. The specimens obtained were rather small, measuring about 12 mm long by 6 mm broad.

Localities. Misaki, Shirahama in Prov. Awa, Susaki.

14. *Thysanozoon brocchii* (Grube)

Thysanozoon brocchii, Lang, 1884, p 525–536; Yeri et Kaburaki, 1918, p. 34–35.

This cosmopolitan planarian is fairly common in this district. Generally the dorsal side is purplish gray with numerous similarly colored papillae, though occasionally these are partly whitish or yellowish in the median zone and elsewhere. In two specimens the body margin was found to be light blue.

15. *Cycloporus variegatus* sp. nov.

Pl. I, fig. 5; text figs. 12–14

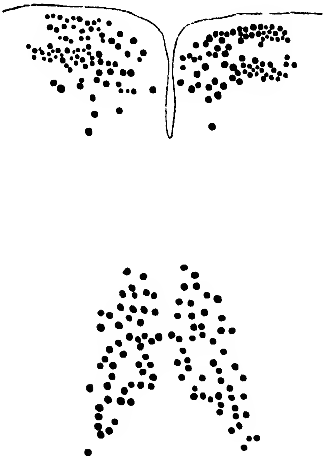
This new species is represented by a single example found beneath a stone on the strand exposed to strong surf in September, 1933.

In the living state the body is oval and leaf-like, with strongly frilled margin, and measures 11 mm in length and 6 mm in breadth. The tentacles are two short, slender projections of the frontal margin of the body. The dorsal side, altogether destitute of papillae much as in the Misaki form of *C. papillosus*, is purplish brown owing to the intestinal contents, and marked all over with white specks radiating from around the median blackish brown band mentioned below. Along the body margin there is a series of lemon yellow spots corresponding to the end-vesicles of the intestinal branches, and just inside of this a narrow colorless zone. The tentacular flaps are also bordered by a deep cadmium yellow band. Extending from the base of the tentacular flaps to the middle of the fourth one-fifth of the body length is a milky white patch, fusiform anteriorly and with about four pairs of side protrusions further behind, this latter part containing a blackish brown band continued anteriorly into a narrow deep yellow stripe, and itself containing some white and yellow spots. The ventral surface is of the same color as the dorsal but without any markings. The pharynx and reproductive organs are discernible as whitish bodies.

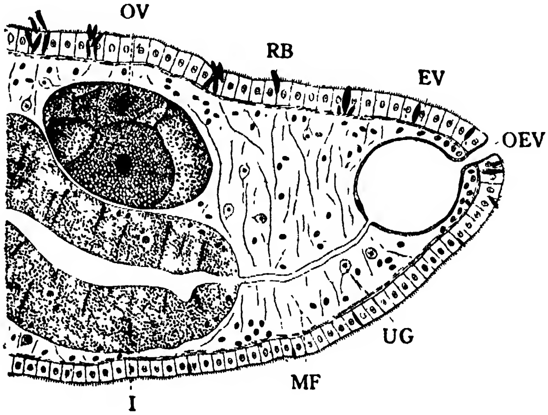
Numerous eye-spots occur on both dorsal and ventral sides of each tentacular flap but especially on the latter in two irregular clusters. In the median milky white patch, at the front end of the yellow median stripe, there are numerous cerebral eye-spots in two incompletely separated groups.

The dorsal epidermis is thicker than the ventral and contains numerous characteristic fusiform rhabdites.

The mouth lying not far behind the tentacular flaps leads into the pharyngeal chamber containing a small ovoid pharynx, which leads behind into the main trunk of the intestine extending in the median line almost the whole body length and sending out some paired branches, which are further subdivided to form an anastomosing system. The terminal branch communicates



Text fig. 12. *Cycloporus variegatus*: eye-spots. ×50.



Text fig. 13. *Cycloporus variegatus*; transverse section through an end-vesicle. ×50. EV end-vesicle; I intestine; MF muscle fiber; OEV opening of end-vesicle; OV ovary; RB rhabdite; UG unicellular gland.

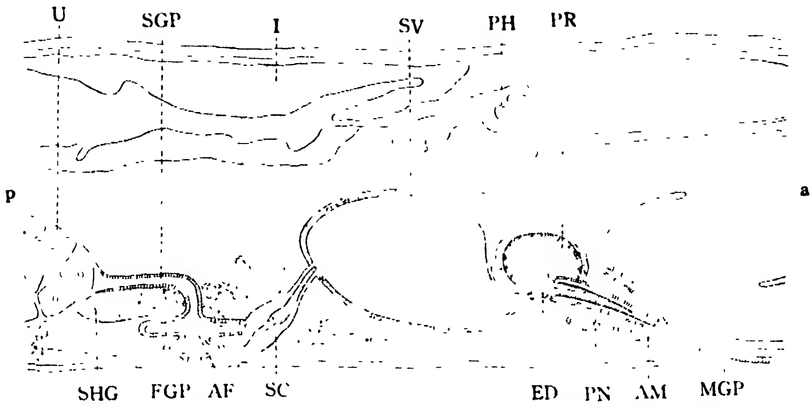
by a slender canal with the end-vesicle, which opens to the exterior by a minute pore on the lateral margin of the body.

The considerably coiled seminal canals, distended with spermatozoa, proceed forwards on the ventral side to near the level of the female genital aperture and turn slightly upwards to open side by side into the seminal vesicle. The latter is a large saccular organ with muscular wall and leads forward into the ejaculatory duct, which eventually makes its way to the apex of the penis, after receiving the short duct from the prostate, a fairly large spherical organ lying dorsal to the base of a long, slender horny stylet representing the penis and lying horizontally in the penis sheath. The antrum masculinum forms an oblique posteriorly directed, annular outbulging opening externally through a narrow tubular passage close behind the pharyngeal chamber.

The female genital aperture lies behind the male. The antrum femininum is of a compressed gourd-like shape and passes upward to the egg-canal, which

soon bends backwards to continue into the two uteri filled with ova.

This species can be clearly distinguished from other species of this genus by the difference in color markings, the presence of narrow canals connecting the intestinal branches and in the end-vesicles.



Text fig. 14. *Cycloporus variegatus*; reproductive organs in sagittal section, diagrammatic. ×80. Index letters as in text figs. 2, 4 and 6.

16. *Prosthiostomum grande* Stimpson

Prosthiostomum grande, Stimpson, 1857, p. 4, 10; Lang, 1884, p. 539; Yeri et Kaburaki, 1918, p. 42-43.
Leptoplana grande, Diesing, 1862, p. 539.
Leptoplana affinis, Diesing, 1862, p. 539.

Three specimens of this species were obtained in May, 1933. The oblong body with a broadly rounded anterior end gradually narrows behind to a bluntly pointed end. The coloration, the arrangement of the eye-spots and the structure of the reproductive organs are quite similar to those of the Misaki forms.

Localities. Bôshû, Matsuwa, Mera, Misaki, Oushima, Susaki.

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Explanation of Plate I

Fig 1. *Pseudoceros micropapillosus* sp. nov. ×3.
Fig. 2. *Pseudostylochus fuscoviridis* sp. nov. ×2.5.
Fig. 3. *Pseudoceros atropurpureus* sp. nov. ×2.
Fig. 4. *Susakia badiomaculata* gen. et sp. nov. ×2.5.
Fig. 5. *Cycloporus variegatus* sp. nov. ×7.5.
Fig 6. *Pseudoceros susakiensis* sp. nov. ×6.5.

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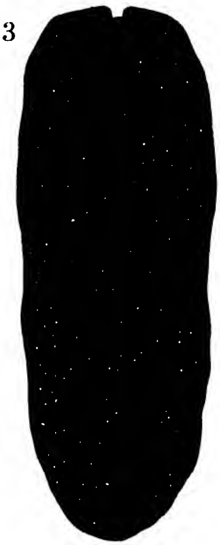

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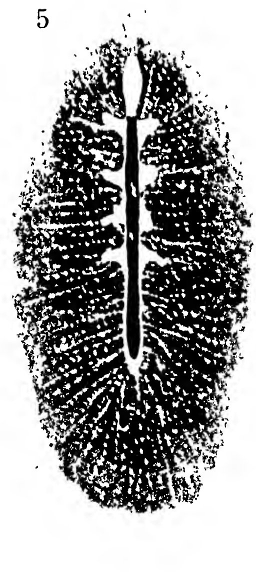

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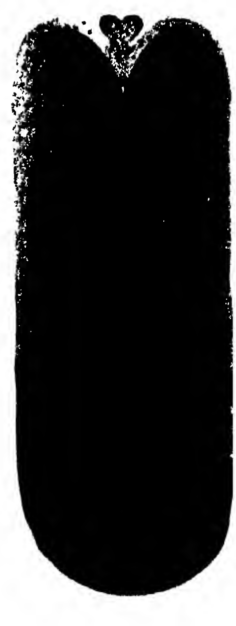

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4. Some Experimental Studies on the Regeneration of the Plerocercoid of Manson's Tapeworm, Diphyllobothrium erinacei (Rudolphi),* with Special Reference to its Relationship with Sparganum proliferum Ijima

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CONTENTS

1. Introduction

There are two species of human tapeworms, whose life histories are not yet adequately known: one is *Diplogonoporus grandis* (Blanchard, 1894) Lühe, 1899, and the other is *Sparganum proliferum* (Ijima, 1905) Manson, 1907. It has been my earnest desire for several years past to known the true nature of the latter.

Then, in my experimental and developmental studies of Manson's tapeworm, *Diphyllobothrium erinacei* (Rudolphi, 1819), large numbers of liguloid plerocercoides of this tapeworm passed through my hands during several years past. On the other hand, students of regeneration in planarians have found that injury to the body causes many heads and tails to develop from one worm. I think that the phylogenetic relationship of planarians and ligulae is very close; so I carried out experiments to see if when injured ligulae were transplanted into the second intermediate host, branched forms similar to those of planarians

*That *D. erinacei* (Rudolphi, 1819) is the correct name of *D. reptans*, *D. okumurai*, *D. mansoni*, *D. decipiens*, *D. ranarum* and *D. houghtoni* was reported by the author in 1933.

could be obtained. Further experiments were made to ascertain whether asexual reproduction of the ligulae takes place in the second intermediate host. Finally the histology of *Sp. proliferum*, normal ligula and artificial branched forms of ligula was studied comparatively and the relationships of the species concerned were considered.

This question has been studied during the past several years under the direction of Dr. Sadao Yoshida, to whom I am greatly indebted for kind guidance. I also wish to thank Dr. Kadzunaga Toyoda for his valuable help especially in the way of operations on experimental animals, and Mr. Minoru Aono for his caretaking of my experimental animals.

2. Experimental Studies

a) Experimental Method

The ligulae used were collected from many species of Japanese snakes (*Elaphe quadrivirgata quadrivirgata* (Boie), *E. quadrivirgata atra* (Jan), *E. conspicillata* (Boie)), Japanese weasels (*Lutreola itatsi itatsi* (Temminck)) and Korean hedgehogs (*Erinaceus orientalis* Allen). The experimental animals used were the domestic rabbit (*Oryctolagus cuniculus* var. *domesticus* (Gmelin)), guinea pig (*Cavia cobaya* Schreber), crab-eating monkey (*Macacus cynomolgus* Wagner) and domestic fowl (*Gallus domesticus* Brisson). Dogs freed of intestinal parasites were used for the final host.

b) Regeneration Experiments on Plerocercoid of *Diphyllobothrium erinacei* (Rudolphi)

i) Branched Plerocercoid of *D. erinacei* (figs. 1–40)

1. *Can branched forms of ligula be produced by injury and transplantation into the second intermediate host?*

Ligulae with a longitudinal incision on the head or tail and a diagonal one on the body were transplanted into the abdominal cavity, hypodermis or inguinal region of rabbits or guinea pigs as in the following table.

Table 1

Experiment No.	Host of ligula	Experimental animals and transplantation region	Number of injured worms transplanted	Ligulae recovered from experimental animals: Branched form	Ligulae recovered from experimental animals: Filamentous form	Duration of experiment in days
1	snake	hypodermis of guinea pig	10	some	some	10
2	,,	abdominal cavity of rabbit	20	6	9	30
3	weasel and snake	,,	20	0	3	22

4	weasel	abdominal cavity of rabbit	20	0	3	10
5	snake	inguinal region of rabbit	6	putrefied		11
6	,,	abdominal cavity of rabbit	5	6	some	11
7	,,	inguinal region of rabbit	25	1	some	11
8	,,	abdominal cavity of rabbit	15	4	9	5
9	,,	,,	10	5	11	16

In these experiments (Nos. 1–9), some of the injured ligulae assumed branched form in the abdominal cavity, hypodermis or inguinal region of rabbits or guinea pigs. The filamentous form probably originated by separation or union at the incisions. The greater number of these branched or filamentous forms were shorter than the transplanted worms. In experiments Nos. 6 and 9, more ligulae were recovered than transplanted, apparently owing to disruption.

2. *Can branched form be produced in the final host?*

To settle this question rabbits and dogs were used, as shown in table 2.

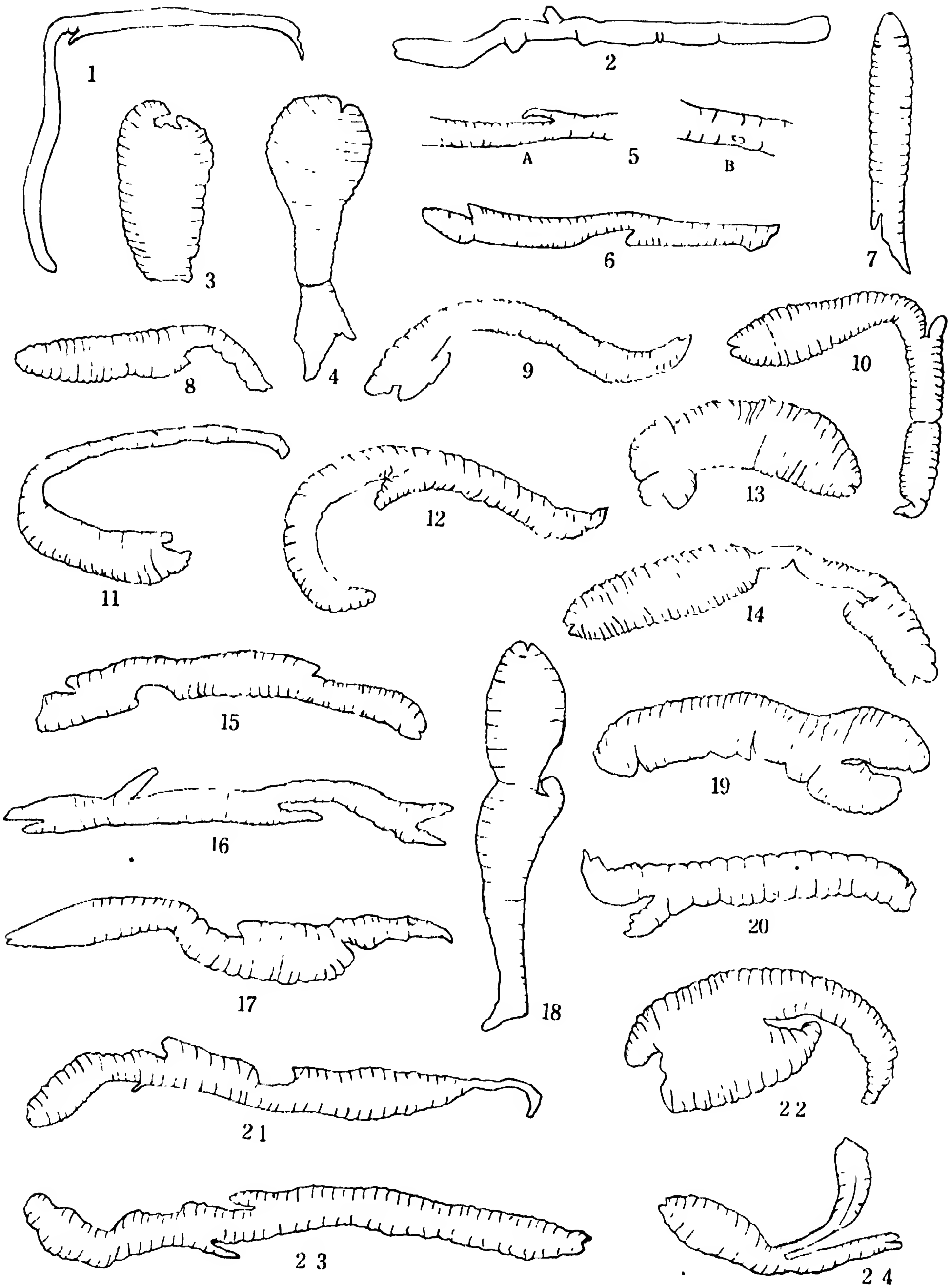
Table 2

Experiment No.	Second intermediate host (rabbit)						Final host (dog)		
	Host of ligula	Experimental animals and transplantation region	Number of injured worms transplanted	Ligulae recovered from experimental animals		Duration of experiment in days	Number of branched ligulae fed to dog	Adult worms recovered	Duration of experiment in days
				Branched form	Filamentous form				
10	snake	abdominal cavity of rabbit	20	5	17	8	5	0	34
11	,,	,,	many	5	9	7	5	0	10
12	,,	,,	20	3	9	10	3	0	11

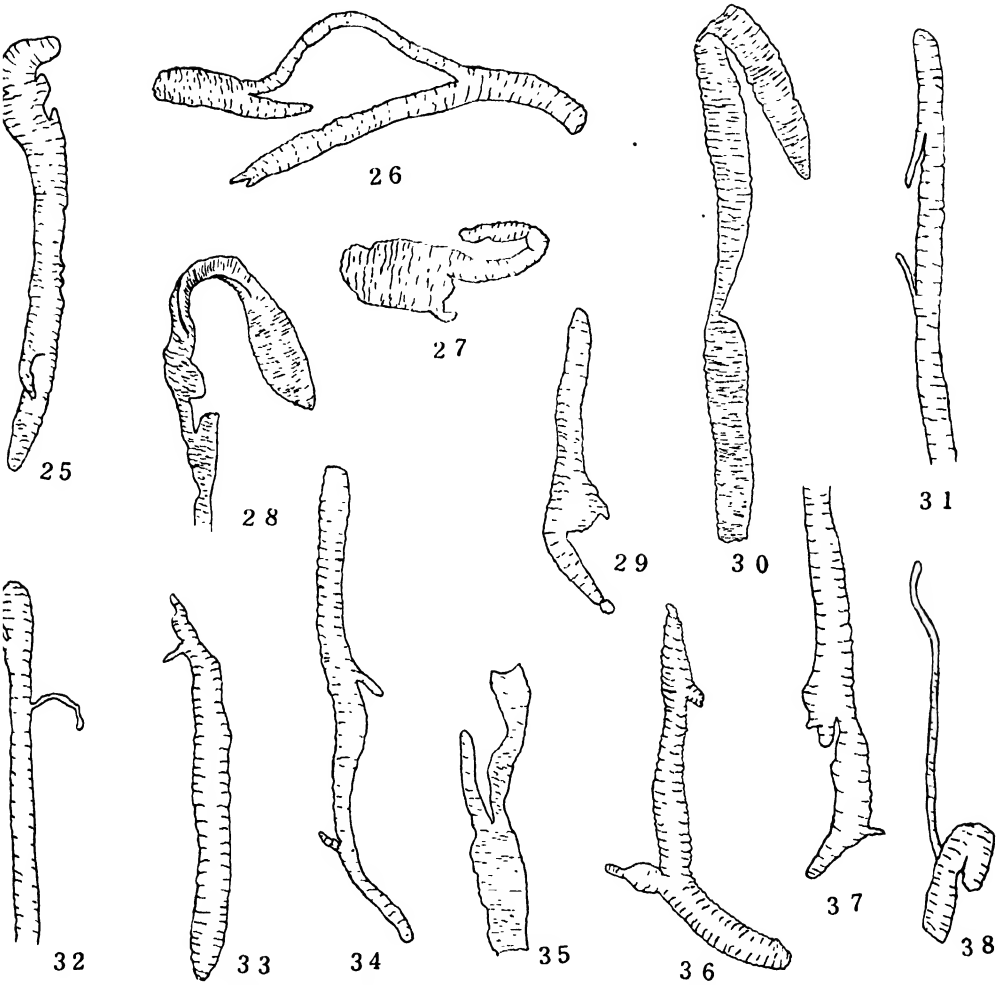
Why the ligulae did not develop in the final host in these experiments is hard to understand. Ijima and Tashiro also could not parasitize dog with *Sp. proliferum*.

3. *Can injured ligulae develop into branched form when fed to second intermediate host?*

Injured ligulae were fed to rabbits, guinea pigs, monkeys or domestic fowls, with the result shown in table 3.



Figs. 1–24. Regenerated branched plerocercoides of *D. erinacei* recovered from rabbits and guinea pigs.



Figs. 25–38. Regenerated plerocercoides of *D. erinacei* recovered from monkeys.

Table 3

Experiment No.	Host of ligula	Experimental animals	Number of worms fed	Ligulae recovered from experimental animals: Branched form	Ligulae recovered from experimental animals: Filamentous form	Duration of experiment in days
13	snake	guinea pig	10	2	0	12
14	,,	,,	10	0	0	12
15	,,	rabbit	20	0	1	40
16	,,	,,	about 80	9	many	18

17	snake	rabbit	30	0	3	15
18	snake and hedgehog	monkey	168	11	52	9-18
19	,,	,,	48	3	9	20
20	weasel	fowl	30	0	0	24
21	,,	,,	15	0	0	8
22	snake	,,	40	0	0	14-21
23	,,	,,	40	0	0	14-21

The injured ligulae from snakes, weasels or hedgehogs went through the intestinal wall of rabbits, guinea pigs and monkeys, and developed into branched form; those from the fowls gave negative results. In these experiments, the ligulae that went through the intestinal wall were very few, but in my other experiments with normal uninjured ligulae the result was similar.

Fig. 39 Fig. 40

Figs. 39-40. Regenerated branched plerocercoides of *D. erinacei* recovered from rabbits and guinea pigs.

ii) Asexual Reproduction of Plerocercoid of *D. erinacei*

1. *Can ligulae regenerate the head in the second intermediate host?*

Ligulae deprived of head and tail were transplanted into the abdominal cavity and inguinal region of rabbits and guinea pigs or fed to them and some days after the recovered ligulae were fed to experimental dogs; but as shown in table 4, ligulae thus treated never developed in the intestine of the final host, as already reported by me (1933).

In these experiments (Nos. 24–40) as in Nos. 6, 9, 10, the ligulae deprived of head lived in the second intermediate host, and some of them regenerated

Table 4

Experiment No.	Second intermediate host (rabbit, guinea pig)					Final host (dog)			
	Host of ligula	Experimental animal and transplantation region or feeding	Number transplanted	Number recovered	Duration of experiment in days	Experimental animals	Number of worms fed	Adult worms recovered	Duration of experiment in days
24	snake	inguinal region of rabbit	40	2	11	dog	2	2	33
25	,,	abdominal cavity of rabbit	25	14	14	,,	14	12	32
26	,,	fed to rabbit	25	0	15				
27	,,	abdominal cavity of rabbit	28	7	6	dog	7	0	26
28	,,	,,	28	13	30	,,	13	0	42
29	,,	,,	30	12	12	,,	12	0	12
30	,,	,,	30	23	12	,,	23	0	16
31	,,	,,	20	0	6				
32	,,	,,	20	20 (Nos. 32–35)	11 (Nos. 32–35)	dog	5	0	1
33	,,	,,	20			,,	5	0	9
34	,,	,,	20			,,	5	1	9
35	,,	,,	20			,,	5	3	30
36	,,	,,	20	10	13	,,	10	0	10
37	,,	,,	15	41 (Nos. 37–40)	19 (Nos. 37–40)	,,	10	0	4
38	,,	,,	15			,,	10	0	13
39	,,	,,	15			,,	10	0	13
40	,,	,,	15			,,	10	3	14

their heads and developed in the final host. But even with uninjured ligulae, the results were frequently negative.

2. *Can a fragment of headless ligula regenerate in the second intermediate host?*

Small pieces of headless ligulae were transplanted into the abdominal cavity of rabbits with the results shown in table 5.

The result of these experiments (Nos. 41–45) was the same as in table 4. In experiments Nos. 24–44 the worms were cut with a knife, but the fragmentation was usually effected in water or normal saline solution. Therefore

Table 5

	Second intermediate host (rabbit)					Final host (dog)			
Experiment No.	Host of ligula	Experimental animals and transplantation region	Number transplanted	Number recovered	Duration of experiment in days	Experimental animals	Number of worms fed	Adult worms recovered	Duration of experiment in days
41	snake	abdominal cavity of rabbit	many pieces	20 (fig. 42)	4				
42	"	"	"	17 (fig. 41)	10	dog	17	11	13
43	"	"	"	2	9	"	11	0	12
44	"	"	"	5	9	"			
45	"	"	"	4	9	"			

the following experiment was made.

Experiment No. 46

Many ligulae left in water separated into many pieces by natural cytolysis, and from among them thirteen headless pieces were transplanted into the abdominal cavity of a rabbit. Eighteen days after, the rabbit died and three living plerocercoides were recovered from it.

Fig. 41

Fig. 41. Regenerated pieces of plerocercoides of *D. erinacei* recovered from the abdominal cavity of rabbit.

Fig. 42

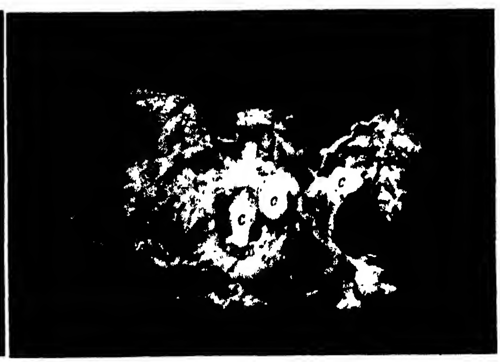


Fig. 42. Plerocercoides of *D. erinacei* enclosed in the omentum of rabbit. *c* capsule.

3. Histological Studies of the Plerocercoides of *D. erinacei* and *Sp. proliferum* Ijima

Histological studies of the plerocercoid of *D. erinacei* have been undertaken by Ijima and Kentarô Murata (1889), Takekichi Sugai (1906), Noboru

Nakamura (1907), Junichi Maejima (1910), Ryô Andô and Shirô Itô (1921), and Shirô Yamada (1923). According to Andô and Itô, the histology of human ligulae is the same as in the frog's, and three types can be recognized, young type, somewhat older type and old type. Yamada found that the ligulae of dogs and frogs are histologically not different from each other; his observations of sections of the head, middle piece and tail showed that the histology is different according to the degree of development of the worm (table 6).

The histology of *Sp. proliferum* was studied by Ijima (1905), Yoshida (1914), Kodama (1917) and Tashiro (1920); the latter paid especial attention to the microchemistry, biology, histology, pathology etc. of this worm.

I have summarized the observations of Andô and Itô, Yamada and Tashiro in table 6, for a comparative histology of ligula and *Sp. proliferum* and as a preliminary to my own studies of the histology of the two worms.

a) Materials and Method

The plerocercoides of *D. erinacei* were from Korean hedgehogs and preserved in formalin. Both big and small ligulae from the laboratory specimens were examined. The branched ligulae were those that had lived for 15 and 30 days respectively in the abdominal cavity of rabbits and there regenerated; they were already shown in figs. 16 and 24, and were preserved in formalin. The material of *Sp. proliferum* was from the original specimens of Ijima (1905, Tôkyô) preserved in formalin. Imbedding was done in paraffin, and the sections, 7–10 μ thick, were stained with eosin and Delafield's hematoxylin.

b) Microscopical Structure and Comparison

(Figs. 44–58)

According to Andô and Itô, the tissues of ligula differ according to age. Tashiro found the structure of *Sp. proliferum* to differ accoding to individuals. I have also found similar individual difference in my slides, so that the following description is based on slides of many specimens.

i) General Structure

In both the worms under consideration, three regions can be distinguished in a cross section, viz. cuticle, cortex and medulla (parenchyma). The muscle is weakly developed in the cortex, but well in the medulla. The basement membrane and circular muscle fibers underlie the cuticle. The medulla on the inner side of the circular fibers is reticular in structure, and studded with longitudinal fibers. The dorsoventral muscle traverses the medulla. The fusiform, nucleated subcuticular cells are in one or several rows. The calcareous corpuscles are irregularly elliptical and show concentric striations. The excretory canal is lined by cuticle and terminates in flame cells. The medulla is reticular in structure and contain muscle fibers, calcareous corpuscles and excretory canals. The muscular

Table 6

Species	Plerocercoid of *D. erinacei*	Plerocercoid of *D. erinacei*
No.	No. 1	No. 2
Describer	Yamada	Yamada
Host of plerocercoid	dog (fed with infected *Cyclops*)	frog (fed with infected *Cyclops*)
Length of plerocercoid or type	25×0.2 cm, 29×0.15 cm	10×0.7-0.8 cm
Fixing	saturated sublimate	saturated sublimate
Staining	eosin and hematoxylin	eosin and hematoxylin
Thickness of cuticle	0.0051-0.00132 mm	0.0067 mm
Circular and longitudinal muscle of cortex	no gross difference in head and tail	a little developed
Subcuticular cells	3-4 rows in head, one row in tail, arranged irregularly	one row arranged irregularly; 0.00618×0.00309 mm
Calcareous corpuscle	less in tail, round, oval, elliptical, long elliptical	round, elliptical, long elliptical; 0.0072×0.0055 mm 0.01914×0.00127 mm
Muscle fiber	well developed in head, a little developed in tail; longitudinal muscle well developed in head, but a little developed in tail; transverse muscle a little in head, but undeveloped in tail	developed to some degree; longitudinal muscle less developed than in No. 1; transverse muscle scarcely ever seen
Parenchyma cells	situated in head and tail	various sizes; round, spindle-shaped, elliptical
Excretory canal	wall covered with cuticle and connective tissue	wall covered with cuticle

Table 6 (continued)

Plerocercoid of *D. erinacei*	Plerocercoid of *D. erinacei*	*Sparganum proliferum*
No. 3	No. 4	No. 5
Yamada	Andô and Itô	Tashiro
frog (naturally infected)	man and frog (naturally infected)	man
15 cm	young type, somewhat older type, old type	
saturated sublimate	formalin	formalin, absolute alcohol, Zenker's solution, Orth's solution
eosin and hematoxylin	eosin and hematoxylin	eosin and hematoxylin
0.0039 mm (tail), 0.00721 mm (head)	0.0042–0.014 mm	about 0.008 mm, but different according to regions, broken or thin at side
recognized more clearly than in No. 2	thin, circular and longitudinal muscle recognized	poorly developed, circular muscle in one row, longitudinal muscle forming small bundles
one or two rows, arranged irregularly; 0.0036×0.003 mm 0.00412×0.00309 mm	one or many rows, arranged irregularly; large cells situated in inner region, shape varied; 0.0042–0.028×0.0028–0.014 mm	one or two rows, arranged irregularly, cell large with elliptical or fusiform nucleus
0.0154×0.00618 mm 0.0155×0.0134 mm	a few of young type, large numbers of old type; 0.0084–0.0196×0.007–0.018 mm	number different according to individuals and parts of body; elliptical, round or irregularly round; 0.016×0.008 mm, 0.01×0.016 mm
reticular connective tissue seen; longitudinal muscle more developed than in No. 2, but tail is less developed than head; transverse muscle same as in No. 2	a few in young worm, many in old worms; longitudinal muscle in many bundles; transverse muscle jumbled together	longitudinal muscle well developed, but poorly developed in the bud; transverse muscle very poorly developed; dorso-ventral muscle well developed in head
same as in No. 2	large cells a few in young, many in old; reticular structure poorly developed in young, well developed in old; a few round and elliptical eosinophil cells	reticular, consisting of round, fusiform and building cells
same as in No. 2	wall covered with cuticle, a few subcuticular cells present around wall in young worms, many in old ones	wall of two types, thin transparent membrane with small elliptical cells or thick and transparent with longitudinal fibers; opening on tail

EXPLANATION OF FIGS. 44–58

Fig. 44. Cross section of plerocercoid of *D. erinacei*, young type.
Figs. 45–46. Cross section of regenerated plerocercoid of *D. erinacei* recovered from rabbit.
Figs. 47–50. Cross section of *Sp. proliferum*.
Fig. 51. Magnified view of a part of fig. 47 (*Sp. proliferum*).
Fig. 52. Magnified view of a part of fig. 44 (plerocercoid of *D. erinacei*).
Fig. 53. Magnified view of a part of fig. 45 (regenerated branched plerocercoid of *D. erinacei*).
Figs. 54–57. Cross section of regenerated branched plerocercoid of *D. erinacei*.
Fig. 58. Cross section of plerocercoid of *D. erinacei*.

B. u. bud
C. c. calcareous corpuscle
C. u. cuticle
E. c. excretory canal
E. Pa. excretory canal in medulla
E. Pe. excretory canal in cortex
F. l. folding of cuticle
L. m. longitudinal muscle
P. a. parenchyma (medulla)
P. e. cortex
S. c. subcuticular cell

bundles are large and well developed. The excretory canals of the medulla are larger than those of the cortex.

In ligulae of very different developmental stages, the cross section is generally flat (figs. 44, 58). In what I call the younger of the two types, the cuticle is thin and the muscle moderately developed. The size and number of excretory canals differ according to individuals.

In regenerated branched ligula (figs. 45, 46, 54–57) the cross section is round, as in *Sp. proliferum*. The incised cuticle is regenerated, and the cortex has moved on underneath it to cover up the medulla (figs. 45, 46). The medulla has a round outline. These arrangements are the same in normal ligula and *Sp. proliferum*.

In *Sp. proliferum* the cross section is round, and both the stem and buds are covered by cuticle. The arrangement of the cortex and medulla is the same as in ligula (figs. 47–50).

ii) Comparison of Structures

The cuticle is transparent and of different thickness according to individuals. I can not confirm Tashiro's statement that in *Sp. proliferum* the excretory canals open at the lateral margin, especially on the tails. In some sections of *Sp. proliferum* the cuticle is folded and doubled. The incised cuticle of regenerated branched worms had undergone complete repair (fig. 55) or was in process of regeneration (figs. 45, 46), in which case many subcuticular cells were crowded under the regenerating cuticle (fig. 45, *S. c.*).

In general, the cuticle is thin in young worms and thick in old ones; but it must be remembered that it is constantly falling off at the surface and replaced from below. In *Sp. proliferum* the cuticle is of the same thickness

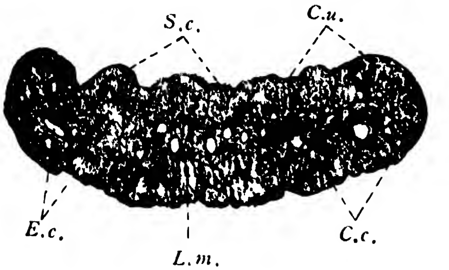


Fig. 44

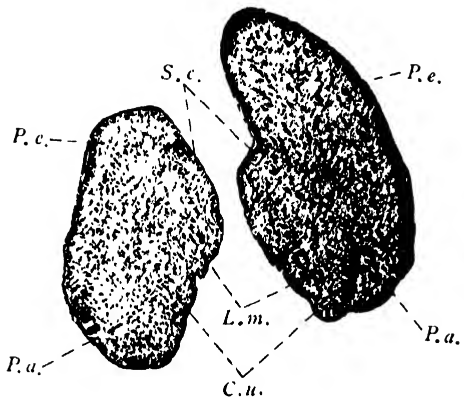


Fig. 45

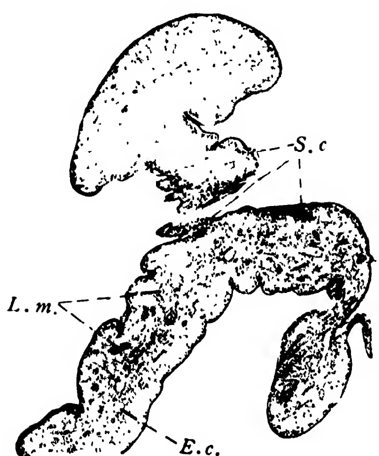


Fig. 46

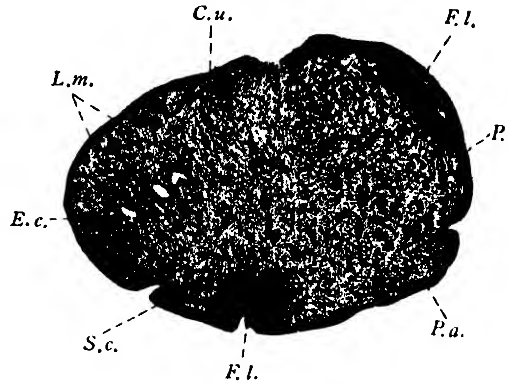


Fig. 47

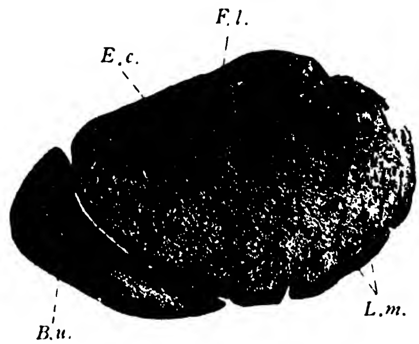


Fig. 48

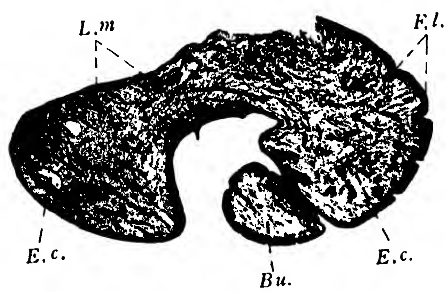


Fig. 49

Fig. 50

Fig. 51

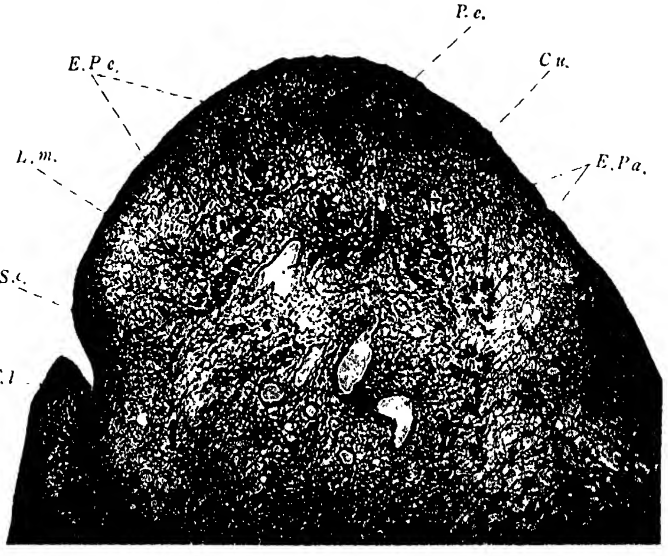


Fig. 52

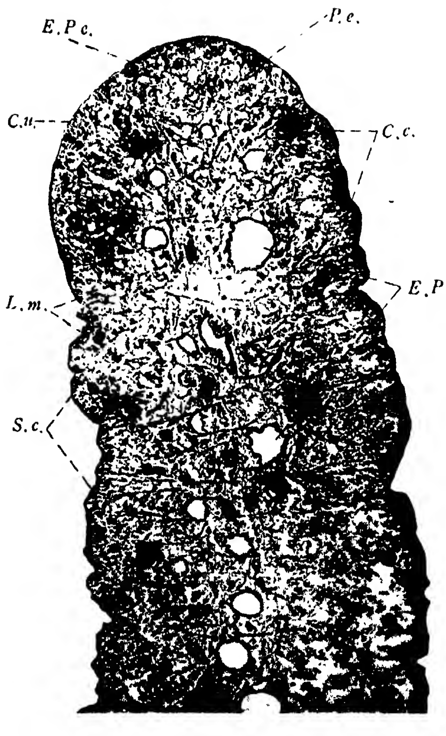


Fig. 53

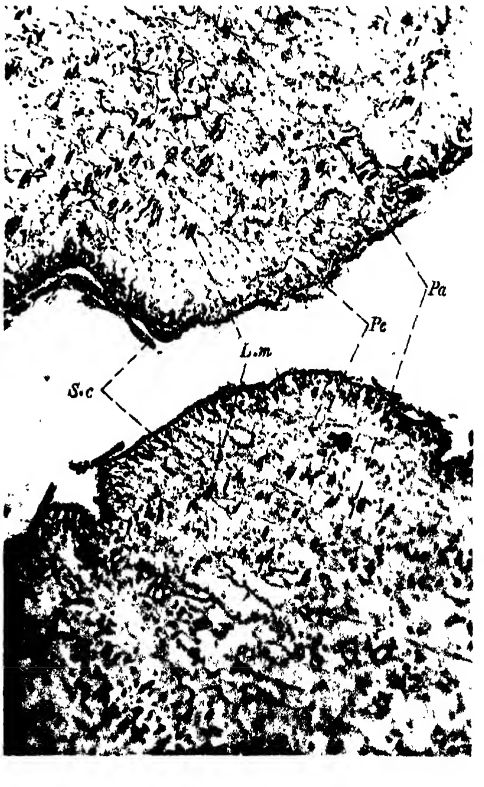


Fig. 54

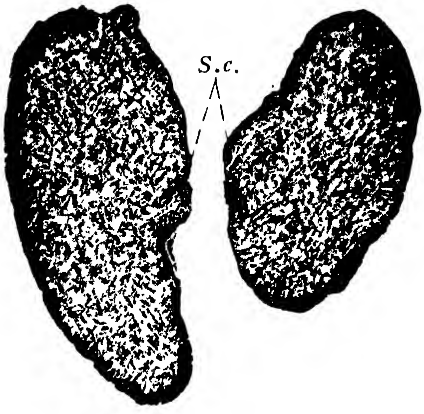


Fig. 56

Fig. 57

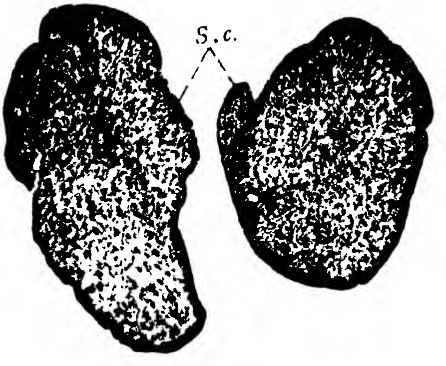


Fig. 55

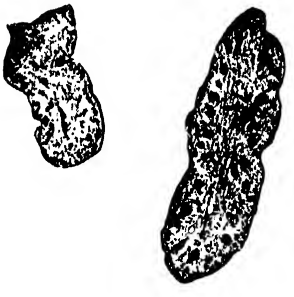
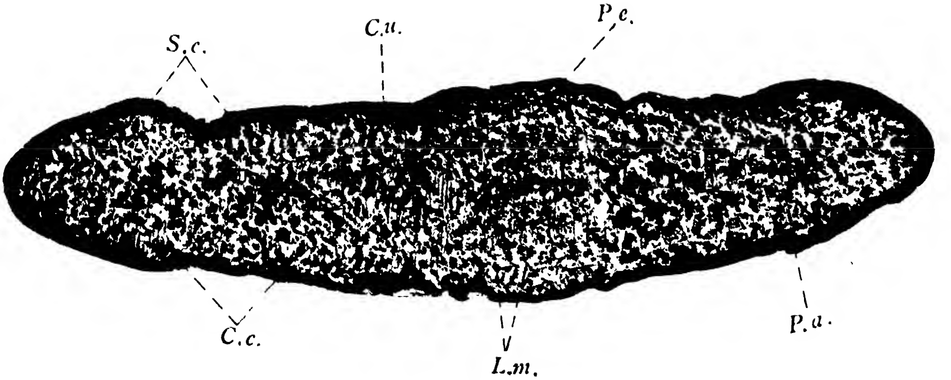


Fig. 58



in the stem as in the bud (figs. 47–50).

The basement membrane is very thin and can not be clearly seen in sections double-stained with eosin and hematoxylin, and in the cortex lie circular and longitudinal muscular fibers, the latter forming small bundles in a reticulate tissue.

The subcuticular cells are comparatively large and fusiform, but some are oval or irregular in form; their nuclei stain deep purple with hematoxylin. The two ends of these cells are sharply pointed and lie in one line or irregularly. They can wander about and produce the cuticle; they gather around the incisions of the cuticle (fig. 46, *S. c.*) in regenerated branched ligulae.

In the medulla, there are longitudinal, transverse and dorsoventral muscles, variously developed in different individuals. In general, the muscles are little developed in young worms but well in old ones. In *Sp. proliferum* the longitudinal muscle is well developed in general, but in the bud it is poorly developed (figs. 18 50). I believe that the bud consists in its earliest stage of the cuticle and cortex only, and that the medulla with the longitudinal muscle develops gradually.

In the regenerated branched ligula in which the cortex and medulla were injured, the parenchymatous muscle is well developed in the stem and bud (fig. 45), but in one in which the cortex alone was injured the muscle was well developed in the stem but entirely absent in the branch.

The transverse and dorsoventral muscles are comparatively poorly developed. The number and size of calcareous corpuscles (figs. 44, 58, *C. c.*) are different according to individuals and body parts. They are scattered in the cortex and medulla and are elliptical or irregular in form, but in my slides of *Sp. proliferum*, they can not be clearly seen, perhaps owing to long preservation which brought about some chemical change.

Excretory canals are present in the cortex and the medulla, being larger in the latter. They are lined by a cuticle surrounded by many subcuticular cells, but in young examples the wall consists of connective tissue only.

Special round or elliptical eosinophil cells have been found in the medulla by Andô and Itô, and Tashiro says that reserve cells stain well with eosin. I believe that the cells seen by them are the same.

Tashiro says that there are three forms of parenchymatous cells, round, fusiform and building. I have identified only the former two in my sections. Tashiro's building cells were not always found in all specimens, but in some they were numerous. I believe that these " building cells " do not necessarily exist in *Sp. proliferum.*

4. Discussion

These experiments show, in the first place, that incised ligulae regenerate and change to the branched form by transplantation into the abdominal cavity or hypodermis of rabbits, guinea pigs and monkeys or by feeding to them (figs. 1–40), but that headless ligulae can not pass through the intestinal wall. The

branched worms are very similar to *Sp. proliferum* in external characters, but in this species the body is shaped like ginger root and may be hollow; there may also be many buds. Therefore ligulae which have undergone some injury, whether chemical or mechanical, may enter the abdominal cavity through the intestinal wall, and migrate in the muscle of the second intermediate host.

In the second place, transplanted headless ligulae can live and regenerate in the abdominal cavity. Their increase in number and asexual reproduction resemble what takes place in *Sp. proliferum.* I believe that if fission of a ligula should occur in the human body by some means or other, its regeneration may possibly take place. Moreover, a ligula may undergo histolysis in water or normal saline solution, in the same way as has been reported by Tashiro for *Sp. proliferum;* and I have reported on the fragmentation of a ligula in the abdominal cavity of rabbits. In view of these facts, I think it possible that if histolysis of a ligula or *Sp. proliferum* occurs somewhere in the human body by some chemical stimulus, the remaining body may regenerate.

Encapsulation (fig. 42) occurs generally in headless, injured or old, or otherwise inactive ligulae.

The microscopical structure and arrangement of tissues in ligula, regenerated branched ligula and *Sp. proliferum* are similar, and in particular regenerated branched ligula is very similar in structure to *Sp. proliferum*, so that we can not recognize any morphological difference between the two.

The presence of many folds in the cuticle of *Sp. proliferum* observed in my sections (figs. 47, 48) suggest another method of bud formation, which I picture to myself as follows.

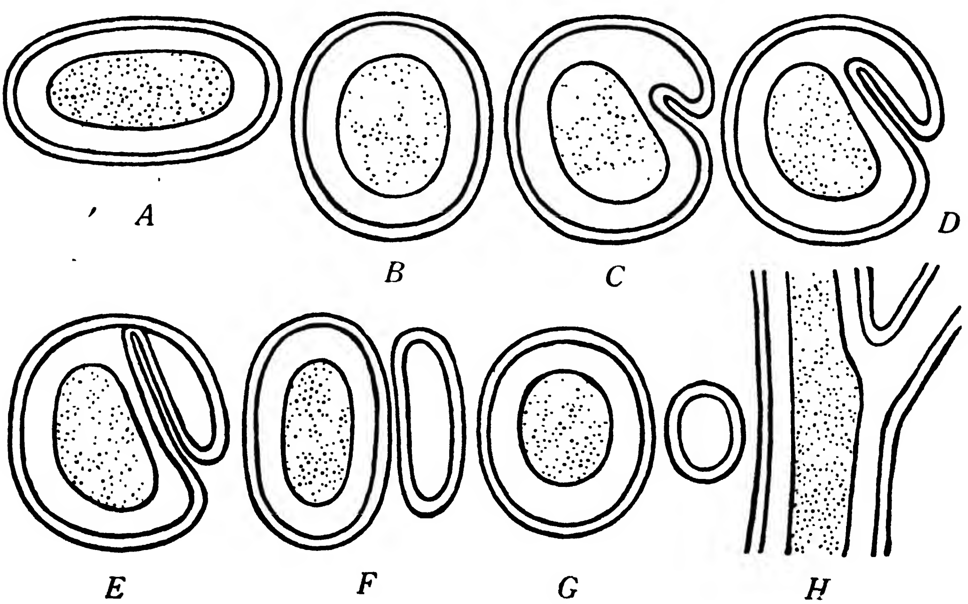


Fig. 43. Diagram of bud formation in *Sp. proliferum.*

Free-living single worms are flat in cross section (fig. 43, *A*), and encapsulated ones round (fig. 43, *B*) in general. The single encapsulated worm may in the course of time be squeezed by the capsule into a round shape, and on further squeezing, the cuticle may be folded in, partially enclosing thereby a portion of the cortex (fig. 43, *C*). If the fold becomes still deeper (fig. 43, *D*), its bottom will reach the opposite cuticle (fig. 43, *E*). If two opposed folds are formed, they will become deeper and fusing with each other, will form a bud (fig. 43, *F*, *G*, *H*). In branched worms, the new bud formed in this way may become detached from the stem, regenerate and form a new individual.

I think the above process may occur in ligula as well as in *Sp. proliferum*. Branched plerocercoides have been discovered in a natural state only in the human body, but they can be produced experimentally in rabbits, guinea pigs and monkeys.

5. Conclusion

The foregoing facts show that the plerocercoid of *D. erinacei* is capable of regeneration and asexual reproduction. The following similarities between ligula and *Sp. proliferum* may be noted: (1) regenerated branched worms resembling *Sp. proliferum* was produced from ligula by experiment; (2) similar asexual reproduction occurs in ligula as in *Sp. proliferum*; (3) there is no histological difference between *Sp. proliferum* and ligula in some cases.

On the other hand, it may be said that some examples of *Sp. proliferum* have many other special characters. Even if the same morphology, same characters and same histology hold good for both ligula and *Sp. proliferum*, we can not conclude that the two species are identical, because in the larval stage the differentiation is still low.

6. Summary

1. These experiments were carried out as one way of bringing out the true form of *Sp. proliferum*. Injured plerocercoides of *Diphyllobothrium erinacei* were transplanted into the second intermediate host or fed to it.

2. The plerocercoides of *D. erinacei* were obtained from snakes, weasels and Korean hedgehogs, and transplanted into the abdominal cavity or inguinal region of rabbits or guinea pigs, or fed to rabbits, guinea pigs, monkeys and fowls.

3. Many regenerated branched worms were recovered from the experimental rabbits, guinea pigs and monkeys, but not from the fowls.

4. Some of the worms which were transplanted into the abdominal cavity of the second intermediate host multiplied.

5. Headless ligulae and fragments of headless ligulae continued to live in the abdominal cavity of the second intermediate host, and developed in the final host.

6. Headless worm due to histolysis in water continued to live in the second intermediate host.

7. Ligulae accidentally injured or cut by mechanical stimulus in the human body may perform asexual reproduction.

8. There are no noteworthy differences between ligula and *Sp. proliferum* in microscopical structure or arrangement of tissues.

9. Regenerated branched ligulae resembling *Sp. proliferum* can be artificially produced from normal filamentous ones. If the same process should occur naturally in the second intermediate host, the following would happen:

a) Worms injured by mechanical stimulus would regenerate into the branched form.

b) Worms which have undergone partial separation into pieces by chemical means would also regenerate.

c) Worms tightly squeezed in their capsules would have their cuticle folded and finally would become branched or separate from the mother body.

10. Injured branched worm if fed to man may migrate into the abdominal cavity, hypodermis or intermuscle through the intestinal wall.

11. Headless ligula if fed to man may not go through the intestinal wall.

12. Even if ligula and *Sp. proliferum* have the same characters in the larval stage, it is not possible to define the exact relationship of their adults, because of low tissue differentiation.

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5. Studies on the Helminth Fauna of Japan

Part 5. Trematodes of Birds, III

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CONTENTS

INTRODUCTION

The birds dissected during the winter of 1933–'34 contained many new trematodes. The fourteen species here described belong to seven families and twelve genera, two of which are new. It is interesting to note that three European species of *Neodiplostomum*, one of which has been reported in part 3 of this series, have also been found in Japan.

HETEROPHYIDAE Odhner, 1914

1. *Spelophallus bucephalae* n. sp.

DESCRIPTION. Large numbers of this worm were found in the ceca of *Bucephala clangula clangula* (Linn.) from Aiti Prefecture. They were all fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam. The small, flat, rod-shaped body is only 0.67–0.95 mm long, with the maximum breadth of 0.24–0.28 mm at the level of the testes. The forebody is more than twice as long as the hindbody. The type is 0.88 mm long by 0.28 mm broad. The nearly terminal oral sucker is 69–75 × 78–96 μ and the barrel-shaped pharynx 36–42 × 33–38 μ. The prepharynx, 48–70 μ long, has the nerve commissure on the dorsal side of its posterior half. The slender sinuous esophagus continues a little in front of the middle of the body into the ceca, similar in structure to the esophagus at the anterior ends. The ceca proper lined by cylindrical epithelium terminate at the anterolateral borders of the testes. The acetabulum, 57–66 μ in diameter, lies at the anterior part of the posterior third of the body.

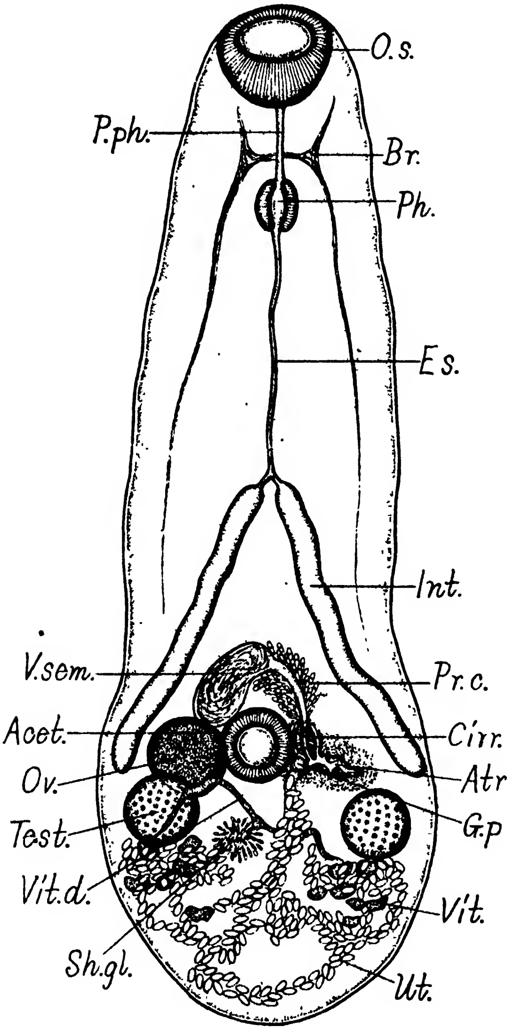

Fig. 1. *Spelophallus bucephalae*; ventral view. Type 0.88 × 0.28 mm.

The transversely elongated oval testes, 54–78 μ long, are situated symmetrically behind the acetabulum. The retort-shaped seminal vesicle and the pars prostatica surrounded by relatively large prostatic cells form an arch just in front of the acetabulum. The papilliform cirrus projects into the genital atrium, which has a thick wall of connective tissue and extends outwards in the form of a diverticulum. The genital pore

lies at the left of the acetabulum.

The subglobular ovary, 60–75 mm in diameter, lies directly anteromedial to the right testis. The shell gland, vitellaria and uterus are arranged as in *Spelophallus primas* Jägersk. The elliptical, light brown, embryonated eggs have an inconspicuous opercular ridge and measure 18–21 × 10–11 μ in life.

DISCUSSION. This species differs distinctly from *Spelophallus primas* Jägersk., 1909, in the size of eggs.

Spelophallus bucephalae n. sp.

SPECIFIC DIAGNOSIS. *Spelophallus* Jägersk., 1909. Body 0.67–0.95 × 0.24–0.28 mm. Oral sucker 69–75 × 78–96 μ. Pharynx 36–42 × 33–38 μ. Acetabulum 57–66 μ in diameter, at anterior part of posterior third of body. Testes transversely elongated oval, 54–78 μ long. Ovary subglobular, 60–75 mm in diameter. Eggs 18–21 × 10–11 μ, with inconspicuous opercular ridge.

Habitat. Ceca of *Bucephala clangula clangula* (Linn.).

Locality and date. Aiti Prefecture; Jan. 23, 1934.

Type and paratypes in my collection.

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PHILOPHTHALMIDAE Travassos, 1921

2. *Cloacitrema ovatum* n. g. n. sp.

DESCRIPTION. Five gravid specimens from the cloaca of *Bucephala clangula clangula* (Linn.). They are flat and approximately oval in outline, somewhat narrower in front and rounded behind, and measure 3.18–3.5 mm in length with a maximum breadth of 1.88 mm at about the middle of the forebody. The dorsal surface of the body is convex, while the ventral is concave and has a transverse or semicircular fold around the acetabulum; there are no body spines. The cuticular and the subcuticular muscle layers are more strongly developed on the ventral side than on the dorsal.

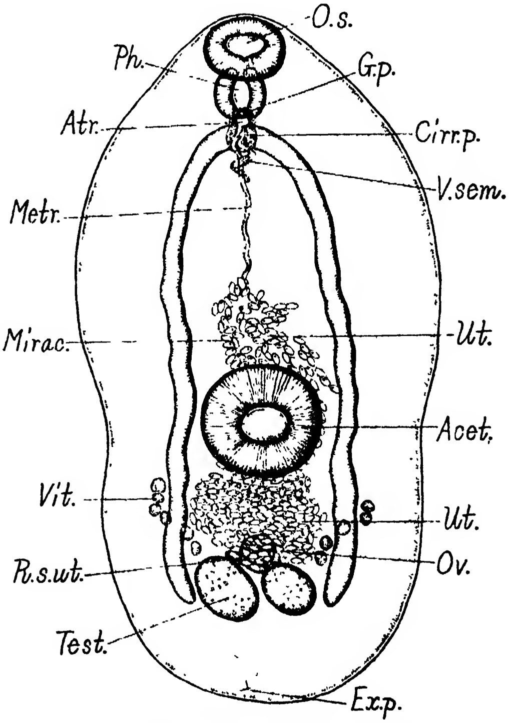

Fig. 2. *Cloacitrema ovatum*; ventral view. Type 3.5 × 1.82 mm.

Immediately under the longitudinal muscles there is an inconspicuous transverse muscle layer. The very numerous dorsoventral muscular bundles attached to the cuticle separate into individual fibers before penetrating the subcuticular musculature; they are very conspicuous and constitute a most outstanding character of the worm.

The oral sucker, 0.35–0.4 mm broad, is usually directed ventrally but may be completely terminal when the anterior end of the body is extended. There is a distinct prepharynx, on the dorsal side of which lies the nerve commissure. The spherical, muscular pharynx is 0.27–0.29 mm broad. The esophagus is very short, so that the cecal bifurcation takes place just behind the pharynx. The fairly wide simple ceca, nearly parallel to each other, terminate short of the posterior end of the body. The acetabulum, 0.58–0.62 mm in diameter, lies at the posterior end of the middle third of the body or a little farther behind.

The ovoid testes, 0.27–0.38 × 0.23–0.28 mm, are situated side by side between the two posterior ends of the ceca. The vesicula seminalis is twisted directly behind the cecal arch. The pars prostatica, lying ventral to the cecal arch and surrounded by a dense mass of prostatic cells, and the short cirrus

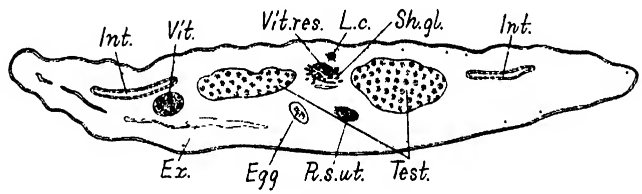

Fig. 3. Transverse section of *Cloacitrema ovatum* at level of testes.

with a thick coat of subcuticular cells are enclosed in a spherical muscular pouch 0.15–0.18 mm in diameter. There is a wide genital atrium lined by a thick cuticle and reinforced by circular and radial muscle fibers; its opening, 45–70 μ wide, lies at the level of the posterior end of the pharynx.

The subglobular, median ovary, 0.13–0.15 × 0.1–0.13 mm, lies just in front of the two testes and dorsal to the uterus. The shell gland and the vitelline reservoir are situated directly behind the ovary. The Laurer's canal is present. The vitelline follicles, 5 or 6 on each side, are arranged obliquely across the ceca on the anterolateral sides of the testes. Posteroventral to the ovary is a very conspicuous elongate or vermiform receptaculum seminis uterinum. The close uterine coils, confined to the intercecal field, are filled with slightly asymmetrically elliptical, non-operculate eggs measuring 32–33 × 17–18 μ. In the pre-acetabular part of the uterus oculate miracidia covered by cilia all over are seen wriggling about in the eggs or hatching out of them; they have a protrusible snout and contain an active redia. The well differentiated sinuous metraterm passes on the ventral side of the vesicula seminalis and cirrus pouch.

The voluminous excretory vesicle with dorsoterminal aperture bifurcates

behind the testes into wide lateral arms extending as far forwards as the oral sucker and giving numerous outpocketings throughout their course.

DISCUSSION. This genus bears a superficial resemblance to *Parorchis* Nicoll, 1907, and *Pygorchis* Looss, 1899, but differs fundamentally from the former in the absence of the collar and body spines, in the length of the esophagus, the position of the acetabulum, genital pore and vesicula seminalis, etc., and from the latter in the position of the acetabulum and testes, in the character of the male terminal genital ducts, in the extent of the uterus, etc. It belongs to Philophthalmidae Travassos, 1921.

Cloacitrema n. g.

GENERIC DIAGNOSIS. Philophthalmidae Travassos, 1921. Body flat, convex dorsally but concave ventrally, without spines. Dorsoventral muscular bundles strongly developed and exceedingly numerous. Prepharynx present. Esophagus very short. Ceca terminating short of posterior end of body. Acetabulum larger than oral sucker, postequatorial. Testes juxtaposed, between posterior ends of ceca. Vesicula seminalis not enclosed in cirrus pouch, far anterior to acetabulum. Pars prostatica surrounded by numerous prostatic cells, enclosed in spherical cirrus pouch, ventral to cecal arch. Genital atrium well developed, with wide opening at level of posterior end of pharynx. Ovary median, just in front of testes. Laurer's canal present. Vitellaria consisting of small numbers of follicles on each side, extending obliquely across ceca on their ventral side, anterolateral to testes. Receptaculum seminis uterinum present. Uterus pretesticular, not extending laterally to ceca. Metraterm well differentiated. Eggs numerous, not operculate, embryonated; miracidia oculate, hatching within uterus, containing active redia. Excretory vesicle large, bifurcating into wide lateral arms extending to oral sucker and giving off numerous saccular outpocketings throughout their course. Excretory pore dorsoterminal. Parasitic in cloaca of birds.

Genotype. *Cloacitrema ovatum*.

Cloacitrema ovatum n. sp.

SPECIFIC DIAGNOSIS. *Cloacitrema;* with generic characters given above. Body 3.18–3.5 mm long, up to 1.9 mm broad. Oral sucker 0.35–0.4 mm broad. Pharynx 0.27–0.29 mm across. Acetabulum 0.58–0.62 mm in diameter. Testes ovoid, 0.27–0.38 × 0.23–0.28 mm, with entire margin. Vesicula seminalis twisted, just behind intestinal bifurcation. Ovary subglobular, 0.13–0.15 × 0.1–0.13 mm. Vitelline follicles 5-6 on each side. Eggs 32–33 × 17–18 μ.

Habitat. Cloaca of *Bucephala clangula clangula* (Linn.).

Locality and date. Aiti Prefecture; Jan. 23, 1934.

Type and paratypes in my collection.

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NOTOCOTYLIDAE Lühe, 1909

3. *Paramonostomum bucephalae* n. sp.

DESCRIPTION. Six specimens of this worm were collected from the ceca of *Bucephala clangula clangula* (Linn.) from Aiti Prefecture. They are 1.5–

2.12 mm in length and 0.45–0.6 mm in maximum breadth at the uterine region. The nearly terminal oral sucker measures 0.07–0.093 × 0.075–0.105 mm. The esophagus is 0.09–0.11 mm long. The ceca terminate by the sides of the posterior end of the ovary.

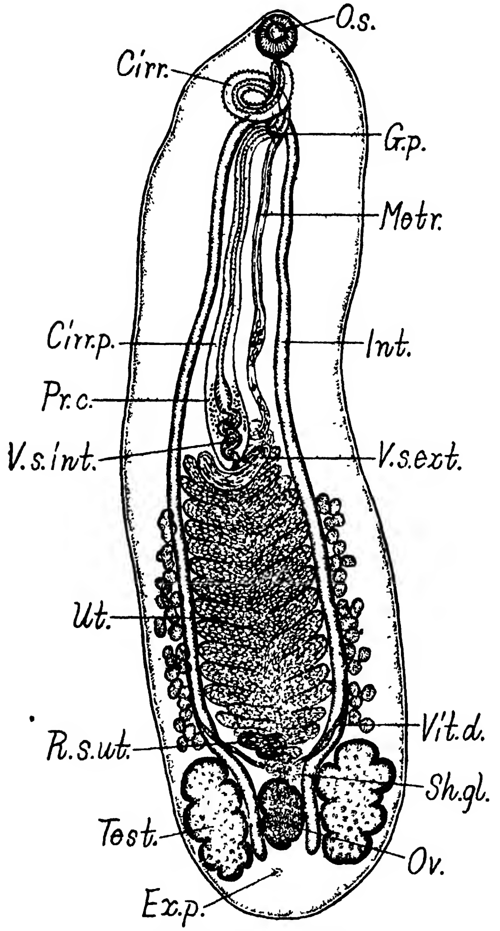

Fig. 4. *Paramonostomum bucephalae*; ventral view. Type 2.12 × 0.6 mm.

The laterally indented testes, 0.225–0.3 × 0.125–0.16 mm, lie symmetrically on either side of the ovary. The long cirrus pouch reaches to the middle of the body, and contains in its enlarged posterior end the twisted vesicula seminalis interna and the club-shaped pars prostatica covered inside with tubercles and surrounded by prostatic cells. The vesicula seminalis externa is not conspicuous. The long protruded cirrus covered with tubercles is 0.45 mm long by 0.04 mm broad in the type 2.12 mm long. The genital pore lies just behind the cecal bifurcation.

The irregularly indented ovary is 0.14–0.15 mm long and 0.11–0.125 mm broad. The shell gland complex lies directly in front of the ovary. The proximal end of the uterus forms a very conspicuous receptaculum seminis. The metraterm is definitely shorter than the cirrus pouch. The eggs are 19–21 × 10–11 μ and have filaments 120 μ long or longer. The lateral vitelline follicles extend anteriorly to near the middle of the body. The dorsal excretory pore lies 0.4 mm in front of the posterior end of the body.

DISCUSSION. This worm is related to *Paramonostomum elongatum* mihi more closely than any of the described species, but differs from it in the sizes of the body and eggs.

Paramonostomum bucephalae n. sp.

SPECIFIC DIAGNOSIS. *Paramonostomum* Lühe, 1909, emend. Body 1.5–2.12 × 0.45–0.6 mm. Oral sucker 0.07–0.093 × 0.075–0.105 mm. Testes 0.225–0.3 × 0.125–0.16 mm. Cirrus pouch reaching to middle of body. Cirrus and pars prostatica beset with tubercles. Ovary 0.14–0.15 × 0.11–

0.125 mm. Conspicuous receptaculum seminis uterinum present. Vitellaria extending to near middle of body. Metraterm shorter than cirrus pouch. Eggs 19-21×10-11 μ in life.

Habitat. Ceca of *Bucephala clangula clangula* (Linn.).

Locality and date. Aiti Prefecture; Jan. 23, 1934.

Type and paratypes in my collection.

LITERATURE CITED

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ECHINOSTOMATIDAE Poche, 1926

4. *Echinostoma corvi* n. sp.

DESCRIPTION. Two specimens of this worm were found on December 14, 1933, in the small intestine of *Corvus corone corone* from Mie Prefecture. They are very stout and only slightly flattened dorsoventrally. At the posterior end of the body there is a small, cone-shaped, dorsal prolongation, on the top of which lies the excretory pore. The cuticle bears minute scale-like spines on the anterior part of the body. The subcuticular longitudinal muscles are very strongly developed. The type is 11.4 mm long and 1.62 mm broad at the level of the ovary. The paratype, about 10 mm long, was cut into pieces in order to determine the exact number of the collar spines in apical view and to measure the eggs dissected out in water.

The head collar, 0.67 mm broad and not conspicuously marked off, bears 47 plump spines arranged in two alternate rows. The end group spines of four each are set by twos in tandem, the posterior row being lateral to the anterior; the smallest innermost spine of the anterior row is 51–54 μ long by 24 μ broad and the largest outermost of the posterior row 75–84 μ long by 33–36 μ broad. The lateral spines vary from 48 to 60 μ in length and from 21 to 24 μ in breadth; the dorsal ones are smaller. The terminal oral sucker is 0.25×0.31 mm and the pharynx 0.23×0.22 mm. The folded prepharynx is 0.05 mm long and the esophagus 0.5 mm long. The ceca

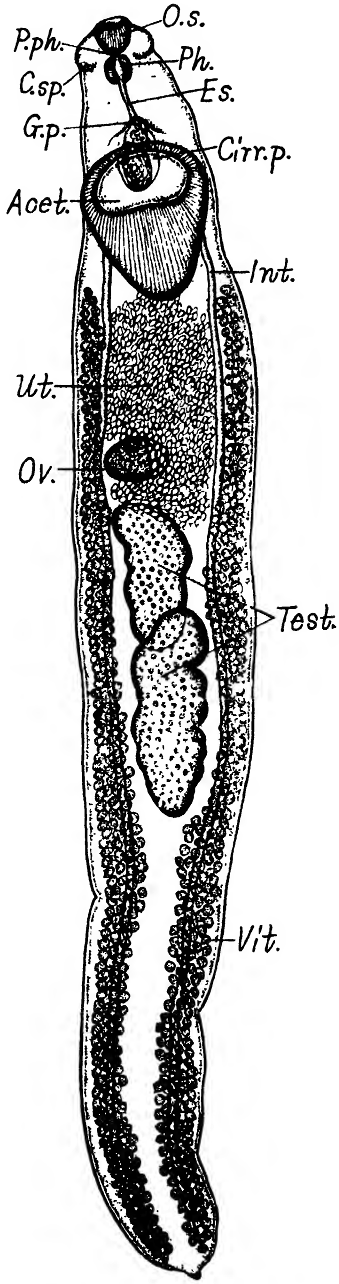

Fig. 5. *Echinostoma corvi*; ventral view. Type 11.4×1.62 mm.

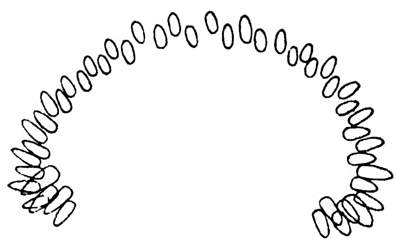

Fig. 6. Collar spines of *Echinostoma corvi.*

terminate as usual near the posterior end of the body. The funnel-shaped acetabulum, 1.25 mm broad, lies at about the middle of the anterior third of the body.

The sausage-shaped testes, 1.38–1.8 × 0.63 mm, are situated one behind the other in the middle third of the body, the anterior partly overlapping the posterior on the dorsal side. The elongate oval cirrus pouch, 0.7 × 0.35 mm, lies anterodorsal to the acetabulum, and contains a large seminal vesicle 0.54 mm long by 0.23 mm broad and a strongly convoluted protrusible cirrus. The pars prostatica and prostatic gland, if present, are not conspicuous. The genital pore opens on the prominent elevation of the body in front of the acetabulum.

The ovoid ovary, 0.35 mm long by 0.53 mm broad, lies slightly to the right of the median line at the junction of the anterior with the middle third of the body. The vitellaria occupy the entire lateral fields behind the acetabulum, and extend a little medially over the ceca both dorsally and ventrally, but do not intrude into the dorsoterminal prolongation of the body mentioned above. The uterine eggs are very numerous, only slightly asymmetrically elliptical or elongate oval and measure 114–126 × 66–75 μ.

DISCUSSION. This species resembles *Echinostoma sarcinum* Dietz, 1909, more closely than *E. chloropodis* (Zeder, 1800) which has also 47 collar spines, but differs from it chiefly in the size of the collar spines and the host. *E. mesotestius* Soloviev, 1912, *E. travassosi* Kalantarian, 1924, and *E. coronale* Kurova, 1927, all parasitic in *Corvus*, are unknown to me, because the original papers are not available. The present species should therefore be regarded as provisional and the specific diagnosis is reserved for a later article.

5. *Echinostoma robustum* n. sp.

DESCRIPTION. This species was found in the small intestine of Formosan *Columba livia domestica* and *Streptopelia chinensis formosa*.

The stout body is 7.8–9.8 mm long by 1.33–2.18 mm broad at about the middle and covered by scale-like spines for the greater anterior part. The forebody has a pronounced concavity on the ventral side as in other members of the genus. The head collar, 0.67–0.85 mm broad, bears 37 spines, the lateral ones being 87–105 μ long by 21–30 μ broad. The innermost of the end group spines is 69–87 × 20–30 μ and the other four vary from 87 to 123 μ in length and from 20 μ to 36 μ in breadth. The subterminal oral sucker is 0.31–0.4 mm broad. The prepharynx is very short. The pharynx is 0.25–0.33 mm long by 0.22–0.28 mm broad. The esophagus is lined by epithelium except for the anterior end; it is 0.77 mm long in the type measuring 7.8 × 1.78 mm. The ceca terminate at the posterior end of the body.

The acetabulum is 0.81–1.08 × 0.8–0.96 mm and lies in the posterior half of the anterior third of the body.

The irregularly lobed testes, 0.5–0.62 × 0.41–0.66 mm, are situated one behind the other at about the middle of the hindbody, with an interval of 0.06–0.12 mm. The ovoid cirrus pouch extends usually to the middle of the acetabulum. The conspicuous vesicula seminalis is 0.26–0.43 mm long and 0.12–0.2 mm broad. The protrusible cirrus is convoluted at the distal end of the cirrus pouch. The median genital pore lies just behind the cecal bifurcation.

The transversely elongated ovary, 0.21–0.31 × 0.4–0.5 mm, lies exactly in the median line, 0.27–0.45 mm in front of the anterior testis. The shell gland complex lies postero-dorsal to the ovary. The well developed lateral vitellaria extend over the ceca both dorsally and ventrally between the acetabulum and the anterior testis and to the median line behind the posterior testis. The closely coiled uterus contains numerous, elliptical, thin-shelled eggs measuring 111–129 × 60–69 μ.

The excretory system is of the usual echinostomatid type.

DISCUSSION. This species differs from the most closely related *Echinostoma columbae* Zunker, 1925, in the posterior extent of the cirrus pouch, in the length of collar spines, in the size of eggs, etc. The absence of body spines in Zunker's specimens was undoubtedly due to postmortem changes.

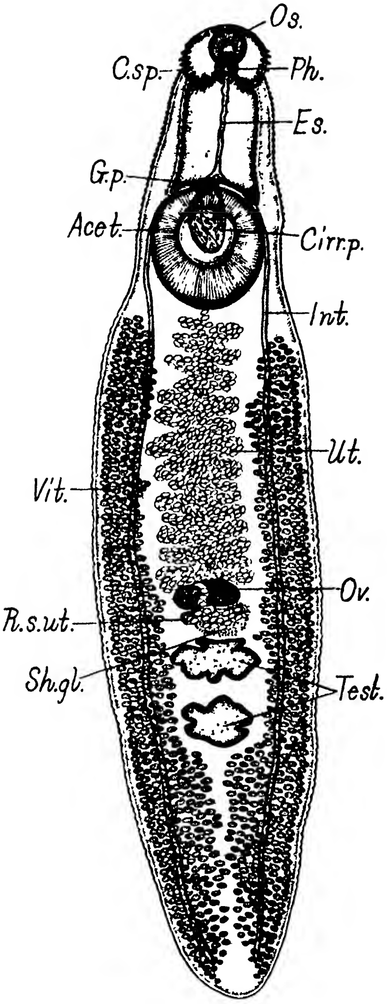

Fig. 7. *Echinostoma robustum*; ventral view. Type 7.8 × 1.78 mm.

Echinostoma robustum n. sp.

SPECIFIC DIAGNOSIS. *Echinostoma* Rud., 1809. Body 7.8–9.8 × 1.33–2.18 mm. Head collar 0.67–0.85 mm broad, with 37 spines. End group spines 5 each (innermost 69–87 × 20–30 μ, others 87–123 × 20–36 μ); lateral spines 87–105 × 21–30 μ. Oral sucker 0.31–0.4 mm broad. Pharynx 0.25–0.33 × 0.22–0.28 mm. Acetabulum 0.81–1.08 × 0.8–0.96 mm, in posterior half of anterior third of body. Testes irregularly lobed, 0.5–0.62 × 0.41–0.66 mm, at about middle of hindbody. Cirrus pouch usually reaching to middle of acetabulum. Ovary 0.21–0.31 mm long by 0.4–0.5 mm broad, median. Vitellaria well developed, reaching to median line in posttesticular field. Eggs 111–129 × 60–69 μ.

Habitat. Small intestine of *Streptopelia chinensis formosa* (type host) and *Columba livia domestica.*

Locality and dates. Formosa; Dec. 31, 1933 (type date), Jan. 12, 1934.

Type and paratypes in my collection.

Literature cited

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Lutz, A. Untersuchungen über die Entwicklungsgeschichte brasilianischer Trematoden. Memorias do Institudo Oswaldo Cruz, T. 17, 1924, p. 83–87.

Nicoll, W. The trematode parasites of North Queensland. II. Parasites of birds. Parasit., Vol. 7, No. 2, 1914, p. 110–111.

Zunker, M. *Echinostoma columbae* n. sp., ein neuer Parasit der Haustauben. Berl. Tierärztl. Wochenschr., 41, 1925, p. 483–484.

6. *Microparyphium capellae* n. sp.

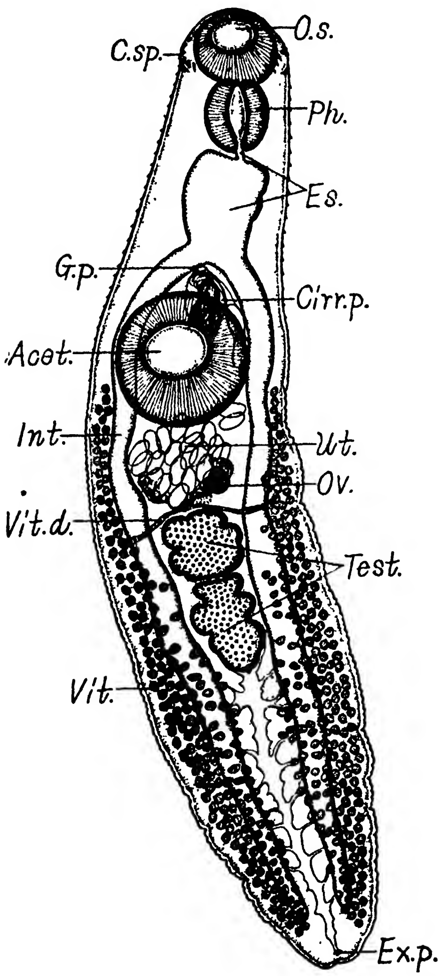

Fig. 8. *Microparyphium capellae*; ventral view. Type 2.5 × 0.56 mm.

Description. Four specimens of this worm were found in the lowest part of the small intestine of *Capella solitaria* from Sizuoka Prefecture. Three of them were stained with hematoxylin-eosin and mounted in balsam on the same slide, and the other was sectioned. The body is plump, broadest behind the acetabulum, and has a rounded anterior and a bluntly pointed posterior extremity. The cuticle is 3–4 μ thick and covered by minute spines on the greater anterior part of the body. The type is 2.5 mm long by 0.56 mm broad at about the middle of the body, the two mounted, somewhat contracted paratypes being 2.14 × 0.7 mm and 2.13 × 0.55 mm respectively. The rudimentary collar bears on each side about ten spines, of which the innermost is 18 μ long and the next largest ones are 24–27 μ long. The lateral spines are in two alternate rows but the dorsal ones in a single row. The oral sucker is 0.2–0.25 mm in diameter. The fairly well developed prepharynx is strongly folded because of the pharynx being partly thrust into the oral sucker. The globular pharynx is 0.16–0.18 mm in diameter.

The pseudoesophagus is expanded to a width of 0.25 mm in the type, while in the paratypes it is more or less folded. The simple wide ceca terminate near the posterior end of the body. The prominent acetabulum, 0.33–0.38 mm across, lies at the junction of the anterior with the middle third of the body.

The irregularly lobed testes, 0.12–0.18 × 0.18–0.25 mm, are situated one directly behind the other in the posterior half of the middle third of the body, with their long axes longitudinal or transverse according to the state of contraction of the body. The oval or pear-shaped cirrus pouch, almost entirely occupied by the large bipartite vesicula seminalis, lies anterodorsal to the acetabulum.

The ovoid, pretesticular ovary, 0.06–0.088 × 0.075–0.1 mm, lies a little to the right or the left of the median line. The female genital complex is of the usual echinostomatid type. The uterine eggs are not very numerous and measure in life 108–120 × 72–78 μ. The relatively small lateral vitelline follicles beginning behind the equator of the acetabulum extend inwards over the ceca both dorsally and ventrally, and terminate a little farther backward than the cecal ends.

The median excretory stem and the two lateral collecting arms give off numerous side branches which split up to form a complex network characteristic of echinostomatids in general.

DISCUSSION. This is the fourth species of *Microparyphium* that has been described, the others being *M. facetum* Dietz, 1909, *M. asotum* Dietz, 1909 and *M. corvi* Ozaki, 1923. The following table shows clearly the specific differences between the known members of the genus and the new one.

	M. facetum Dietz, 1909	*M. asotum* Dietz, 1909	*M. corvi* Ozaki, 1923	*M. capellae*
Body length	4.5-6.5 mm	2.75 mm	2.5–4.92 mm	2.13-2.5 mm
Length of largest collar spines	61.2 μ	36 μ	54 μ	27 μ
Oral sucker in diameter	0.385–0.508 mm	0.293 mm	0.201–0.398 mm	0.2–0.25 mm
Acetabulum	0.693–0.832 mm	0.539 × 0.462 mm	0.513–0.798 mm	0.33-0.38 mm
Eggs	96–100.8 × 55.2–52.8 μ	88.8 × 52.8 μ	102–113 × 68–79 μ	108–120 × 72–78 μ
Host	*Geronticus oxycercus*	*Ichthyoburus nigricollis*	*Corvus macroryhnchus japonensis*	*Capella solitaria*
Locality	Brazil	Brazil	Japan	Japan

Microparyphium capellae n. sp.

SPECIFIC DIAGNOSIS. *Microparyphium* Dietz, 1909. Body 2.13–2.5 × 0.55–0.7 mm. Collar spines indefinite in number, about ten on each side, largest being 27 μ long. Oral sucker 0.2–0.25 mm across. Pharynx 0.16–0.18 mm in diameter. Acetabulum 0.33–0.38 mm in diameter, at junction of anterior with middle third of body. Testes irregularly lobed, 0.12–0.18 × 0.18–0.25 mm. Ovary 0.06–0.088 × 0.075–0.1 mm, a little to one side of median line. Eggs 108–120 × 72–78 μ in life.

Habitat. Small intestine of *Capella solitaria*.
Locality and date. Sizuoka Prefecture; December 21, 1933.
Type and paratypes in my collection.

LITERATURE CITED

Dietz, E. Die Echinostomiden der Vögel. Zool. Jahrb., Suppl. 12, Heft 3, 1910, p. 437-441.

Ozaki, Y. On a new species of *Microparyphium*. Dobutu Gaku Zassi, Vol. 35, No. 412, 1923, p. 65-70. (Japanese.)

EUCOTYLIDAE Skrjabin, 1924

7. *Tamerlania japonica* n. sp.

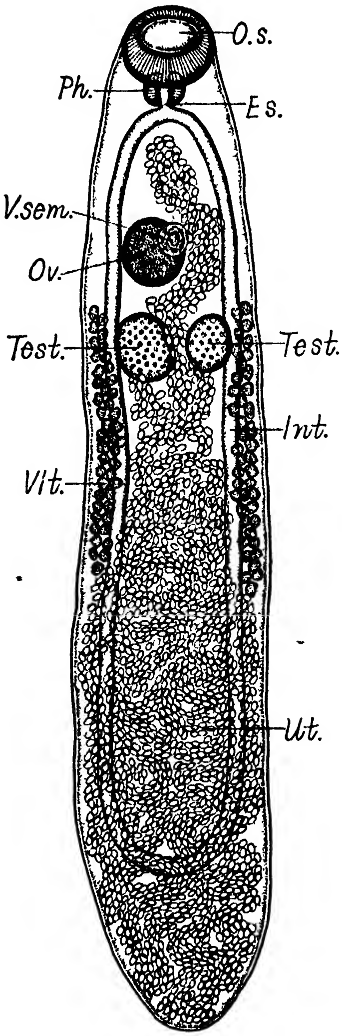

Fig. 9. *Tamerlania japonica*; ventral view. Type 3.0× 0.56 mm.

DESCRIPTION. A number of this worm were found in the urinary tract of *Coccothraustes coccothraustes japonicus* Temm. et Schl. from Mie Prefecture and *Emberiza variabilis* Temm. from Kôti Prefecture. The body is nearly uniform in width, broadly pointed at the extremities and covered by minute spines except at the posterior end. The type is 3.0 mm long by 0.56 mm broad. The subterminal oral sucker, 0.225 × 0.25 mm and with a wide opening 0.16 mm in transverse diameter, is directly followed by the pharynx measuring 0.075 × 0.11 mm. The very short esophagus leads into the intestine from the dorsal side. The simple, relatively wide ceca unite with each other on the dorsal side of the uterus at about the middle of the posterior third of the body.

The oval testes are situated symmetrically just inside the ceca at the junction of the anterior with the middle third of the body, the right one measuring 0.2 × 0.16 mm and the left 0.14 × 0.13 mm. The spherical vesicula seminalis, 0.09 mm in diameter, lies ventromedial to the ovary just in front of its middle. The genital pore opens just behind the intestinal bifurcation.

The globular ovary, 0.16 mm in diameter, lies 0.05 mm in front of the right testis. The uterus occupies all the available space behind the ovary, and ascends on the ventral side between the testes and by the left side of the ovary. The asymmetrically elliptical, dark

brown, thick-shelled, operculate eggs are embryonated and measure in life 42–51 × 24–26 μ. The lateral vitellaria beginning at the level of the anterior ends of the testes extend some distance farther backward than the middle of the body. The vitelline ducts passing transversely along the anterior edges of the testes form a triangular reservoir in the median line.

DISCUSSION. This species differs from the type species, *Tamerlania zarudnyi* Skrjabin, 1924, chiefly in the length of eggs and in the host. Skrjabin states that the esophagus is entirely lacking in his species, but evidently he has overlooked it, so that his generic diagnosis concerning it should be emended to read "short esophagus present". Further he seems to have overlooked the posterior cecal connection, although it is one of the most important characteristics of the genus.

Tamerlania japonica n. sp.

SPECIFIC DIAGNOSIS. *Tamerlania* Skrjabin, 1924; with the generic characters as emended and supplemented in the above discussion. Body 2.5–4.0 × 0.4–0.6 mm. Oral sucker 0.15–0.23 × 0.18–0.25 mm. Pharynx 0.063–0.088 × 0.075–0.11 mm. Ceca uniting posteriorly at about middle of posterior third of body. Testes 0.14–0.23 × 0.13–0.18 mm. Ovary 0.15–0.2 mm in diameter. Vitellaria beginning at level of anterior ends of testes, not reaching to junction of middle with posterior third of body. Eggs asymmetrically elliptical, embryonated, 42–51 × 24–26 μ.

Habitat. Urinary tract of *Coccothraustes coccothraustes japonicus* (type host) and *Emberiza variabilis* Temm.

Localities. Mie Prefecture (type locality), Kôti Prefecture.

Dates. Nov. 16, 1933 (type date), Jan. 12, 1934.

Type and paratypes in my collection.

LITERATURE CITED

Skrjabin, Nierentrematoden der Vögel Russlands. Centralbl. Bakt., II. Abt., Orig., Bd. 62, 1924, p. 86.

HARMOSTOMIDAE Odhner, 1913

8. *Harmostomum syrmatici* n. sp.

DESCRIPTION. A large number of this trematode were found in the posterior part of the small intestine of *Syrmaticus soemmerringii scintillans* (Gould) from Kyûsyû. The almost cylindrical worm is broadest at the middle of the hindbody and more or less pointed at the posterior end but rounded in front. The type is 4.55 mm long by 0.62 mm broad. The subterminal oral sucker is 0.4 mm in diameter. There is a distinct prepharynx, though not measurable with certainty, The relatively large globular pharynx is 0.24 × 0.275 mm. The esophagus looks as if lacking but is distinctly recognizable in strongly flattened specimens. The ceca, recurrent on the sides of the pharynx, extend to the posterior end of the body. The acetabulum, 0.37 mm in diameter, lies a little in front of the middle of the body.

The globular testes, 0.16 × 0.175 mm, lie obliquely tandem at the posterior end of the body, the anterior on the left and the posterior in the median line, separated from each other by the ovary. The convoluted vas deferens has a

muscular wall at its distal end and is surrounded by a small number of cells before entering the cirrus pouch, which is 0.18 mm long by 0.17 mm broad. The distally enlarged cirrus is provided with inner longitudinal and outer circular muscle fibers. The common genital pore lies in the median line at the level of the anterior end of the anterior testis.

The subglobular ovary, 0.22 × 0.2 mm, lies on the right between the two testes. The germiduct arises from the left side of the ovary and after giving off the Laurer's canal unites with the anchor-shaped vitelline reservoir lying anterosinistral to the posterior testis, then turns forwards to lead into the uterine duct passing on the left side of the ovary. The Laurer's canal proceeds backwards as a direct continuation of the germiduct and then turns back on itself at the level of the vitelline reservoir, where it shows a conspicuous dilatation filled with germ cells; it appears to open dorsally at the level of

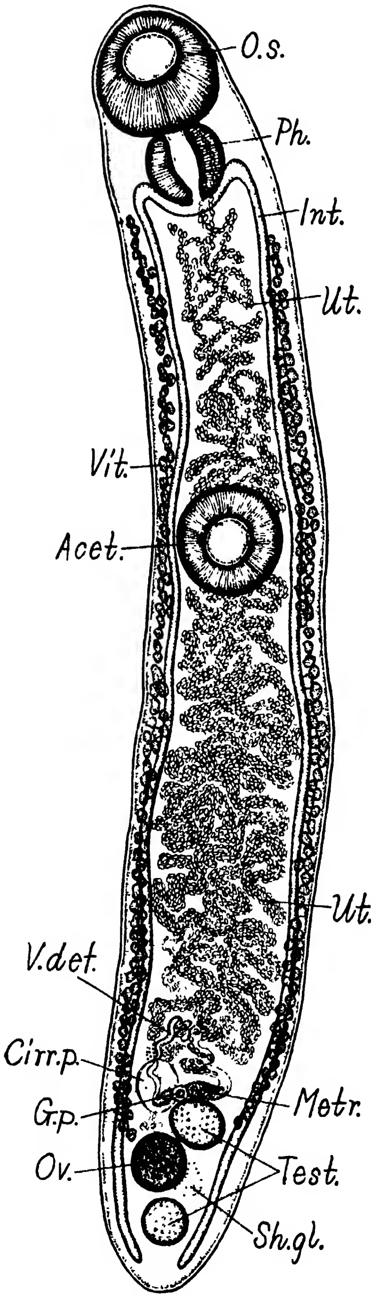

Fig. 10. *Harmostomum syrmatici*; ventral view. Type 4.55 × 0.62 mm.

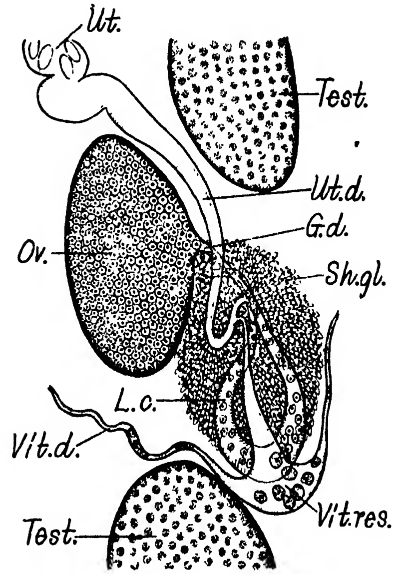

Fig. 11. Ovarian complex of *Harmostomum syrmatici*; ventral view; stretched in anteroposterior direction.

the origin of the germiduct. The shell gland is well developed around the genital ducts mentioned above. The ascending coils of the uterus lie dorsal to the descending; both are confined to the intercecal field, but the anteriormost loop extends farther forwards to the dorsal side of the pharynx. The wide metraterm has a strong muscular wall like the cirrus. The asymmetrically oval, fairly thick-shelled, embryonated eggs measure 24–27 × 15–17μ; the dark brown mature ones have a small nodular thickening at the antiopercular pole. The lateral vitelline follicles begin on the right at the level of the posterior end of the pharynx and a little posteriorly on the left; they terminate at the level of the anterior testis.

The excretory system could not be made out in detail.

VARIATIONS. The anterior end of the uterus lies usually behind the pharynx but may often extend to its dorsal side, as in the type. The anterior extent of the vitellaria is also variable according to individuals; in the majority of cases it stops a little behind the pharynx but may sometimes reach to it. Measurements on paratypes are included in the specific diagnosis.

DISCUSSION. This species resembles *Harmostomum centrodes* Braun, 1901, very closely but differs from it distinctly in the size of the pharynx and in the absence of spines in the cirrus.

Harmostomum syrmatici n. sp.

SPECIFIC DIAGNOSIS. *Harmostomum* Braun, 1899. Body 3.55–5.0 × 0.5–0.65 mm, of almost uniform width. Oral sucker 0.35–0.43 × 0.34–0.425 mm. Pharynx 0.18–0.25 × 0.21–0.28 mm. Acetabulum 0.3–0.4 mm in diameter, slightly pre-equatorial. Anterior testis 0.14–0.21 × 0.11–0.18 mm, posterior 0.16–0.25 × 0.15–0.23 mm. Cirrus unarmed. Ovary subglobular, 0.15–0.22 × 0.14–0.21 mm. Vitellaria beginning at level of posterior end of pharynx or a little behind it. Uterus extending forwards to behind pharynx and often to its dorsal side. Eggs asymmetrically oval, 24–27 × 15–17 μ, with inconspicuous antiopercular thickening in embryonated ones.

Habitat. Posterior part of small intestine of *Syrmaticus soemmerringii scintillans* (Gould).

Locality and date. Kyûsyû; Jan. 18, 1934.

Type and paratypes in my collection.

LITERATURE CITED

Braun, M. Fascioliden der Vögel. Zool. Jahrb., Syst., Bd. 16, 1902, p. 120–122.

LEUCOCHLORIDIIDAE Dollfus, 1934

9. *Leucochloridium sime** n. sp.

SPECIFIC DIAGNOSIS. *Leucochloridium* Carus, 1835. Body 1.1–1.27 mm long, 0.5–0.62 mm broad at about middle of body. Oral sucker subterminal, 0.38–0.43 mm in diameter, constantly larger than acetabulum. Pharynx 0.12–0.13 × 0.13–0.15 mm. Prepharynx and esophagus short. Acetabulum 0.35–0.38 mm in diameter; its center just behind middle of body. Ceca terminating short of posterior end of body. Testes and ovary arranged in a triangle, subglobular or oval, almost similar in size, 0.06–0.1 × 0.075–0.125 mm. Cirrus pouch 0.1–0.15 mm in diameter. Uterus extending to level of anterior end of vitellaria or a little more forward. Eggs asymmetrically oval, 24–30 × 14–

* The specific name refers to the Japanese name of the host.

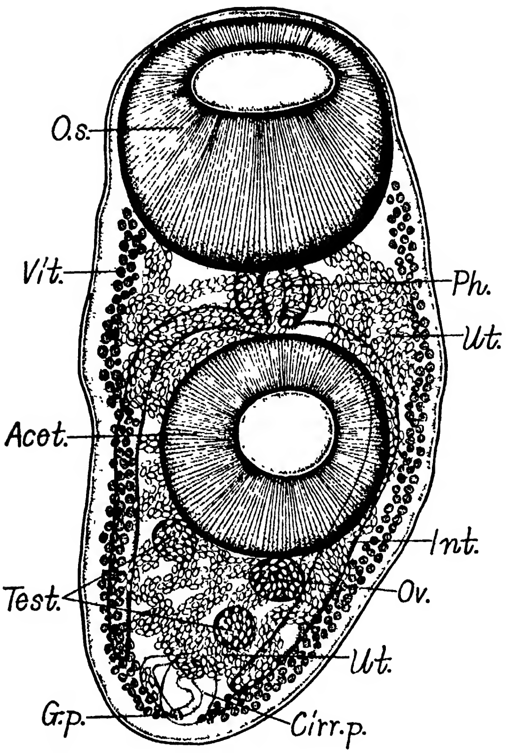

Fig. 12. *Leucochloridium sime;* ventral view. Type 1.2×0.58 mm.

20 μ. Vitelline gland extending from level of posterior part of oral sucker to posterior end of body.

Habitat. Cloaca of *Coccothraustes coccothraustes japonicus.*

Locality and date. Sizuoka Prefecture; December 23, 1933.

Type and paratypes in my collection.

DISCUSSION. According to Mc Intosh's key to species of *Leucochloridium*, the present worm is most closely related to *L. variae* McIntosh, 1932, but differs from it in the relative size of the oral and ventral suckers. Recently Ishii has described a new *Leucochloridium* (*L. japonicum*) from *Graphophasianus soemmerringii.* This species is, however, characterized by the vitellaria terminating at the level of the ovary and by the postequatorial position of the acetabulum, and its eggs measure 22–25×12–13 μ, so that it can safely be neglected here.

LITERATURE CITED

Ishii, N. Studies on avian trematodes, I. Zikken Igaku Zassi, Vol. 16, 1932, p. 1216-1218. (Japanese.)

McIntosh, A. Some new species of trematode worms of the genus *Leucochloridium* Carus, parasitic in birds from northern Michigan, with a key and notes on other species of the genus. Jour. Parasit., Vol. 19, No. 1, 1932, p. 32-53.

STRIGEIDAE Railliet, 1919

10. *Diplostomum vanelli* n. sp.

DESCRIPTION. A number of specimens from the small intestine of *Vanellus vanellus.* They were fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam. The body is sharply divided into a scoop-shaped forebody and a cylindrical hindbody of nearly equal length. In the type the forebody is 0.79 mm long and 0.53 mm broad behind the acetabulum, while the hindbody is 0.79 mm long by 0.41 mm broad. The ventroterminal oral sucker is 48–75×68–84 μ and the barrel-shaped pharynx 54–66×42–54 μ. The prepharynx is 20 μ in maximum length. The esophagus is short and the narrow simple

ceca extend to the posterior end of the body. The lateral suctorial pockets are 90–102 μ long by 45–54 μ thick. The numerous muscular bundles arising from these pockets run backwards on the dorsal side and are attached to the dorsal wall of the hindbody at or near its posterior end, causing the retroflexion of the body. Behind the suctorial pockets and alongside the ceca as far backwards as the holdfast organ there are numerous, irregularly shaped gland cells filled with exceedingly fine granules. The spherical to oval acetabulum, 72–108 μ in diameter, lies at about the middle of the forebody and directly behind it is a round holdfast organ 0.15–0.28 mm in diameter; its anterior border may overlap the acetabulum or be indented in the median line; the median cleft on the ventral surface may sometimes be completely obliterated, especially when the organ is protruded. The adhesive gland, with a posterior median incision is seen at the posterodorsal part of the holdfast organ as a conspicuous mass of nuclei.

The two testes have a marked concavity on the ventral surface as in other members of the genus; the approximately wedge-shaped anterior testis, 0.11–0.18 mm long by 0.2–0.33 mm broad and with its attenuated end directed toward the side on which the shell gland is situated, lies at about the middle of the hindbody; the posterior testis, 0.14–0.2 × 0.28–0.36 mm, occupies the entire breadth of the hindbody. The anterior vas efferens is strongly enlarged directly in front of the anterior testis at the left of the ovary. The voluminous vesicula seminalis lies immediately behind the posterior testis. The ductus ejaculatorius joins the uterus and opens on the ventral wall of the spacious genital atrium, whose triangular opening is directed posterodorsally.

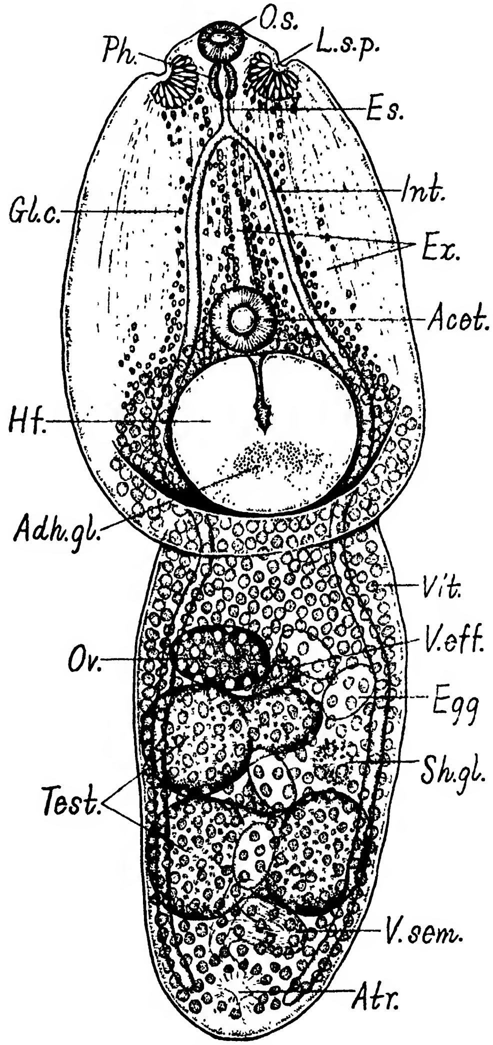

Fig. 13. *Diplostomum vanelli*; ventral view. Type 1.58 × 0.53 mm.

The ovoid ovary, 0.05–0.11 × 0.075–0.16 mm, lies just in front of the anterior testis a little to one side of the median line. The shell gland is closely applied to the attenuated end of the anterior testis. The vitellaria occupying the entire available space of the hindbody extend into the forebody as far as the anterior end of the holdfast organ or a little farther forwards. The large vitelline reservoir lies in the median line between the two testes. The asymmetrically elliptical, light brown eggs are 93–108 × 54–60 μ.

DISCUSSION. This species resembles *Diplostomum colymbi* (Dubois, 1927) more closely than *D. mergi* Dubois, 1932, *D. orientale* mihi*, etc., but differs distinctly from it in the breadth of eggs.

Diplostomum vanelli n. sp.

SPECIFIC DIAGNOSIS. *Diplostomum* v. Nordm., 1832. Forebody 0.68–0.8 × 0.45–0.65 mm, hindbody 0.53–0.8 × 0.32–0.47 mm. Oral sucker 48–75 × 68–84 μ. Pharynx 54–66 × 42–54 μ. Acetabulum 72–108 μ in diameter, at about middle of forebody. Holdfast organ 0.16–0.28 mm in diameter, directly behind acetabulum, sometimes with conspicuous median cleft; its anterior border entire or indented in median line, often overlapping acetabulum. Anterior testis wedge-shaped in dorsal view, 0.11–0.18 × 0.2–0.33 mm, at about middle of hindbody; posterior 0.14–0.2 × 0.28–0.36 mm. Ovary 0.05–0.11 × 0.075–0.16 mm, not exactly median. Vitellaria beginning at level of anterior end of holdfast organ or a little farther in front. Eggs 93–108 × 54–60 μ.

Habitat. Small intestine of *Vanellus vanellus*.

Locality and date. Sizuoka Prefecture; Jan. 29, 1934.

Type and paratypes in my collection.

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Dubois, G. Revision des "hemistomes" et étude de formes nouvelles. Bull. Soc. Neuchâtel. Sci. Nat., T. 56, 1931, p. 375–408.

11. *Neodiplostomum attenuatum* (v. Linst., 1906) La Rue, 1926

Several mature specimens of this worm were found in the small intestine of *Buteo buteo burmanicus* from Sizuoka Prefecture. They were fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam without cover glass pressure.

The following brief note taken from four whole mounts agrees better with Krause's description than with von Linstow's.

Body 1.24–1.57 mm long; forebody 0.66–0.83 × 0.31–0.5 mm, hindbody 0.58–0.74 × 0.26–0.36 mm. Oral sucker 30–54 × 30–60 μ. Pharynx 24–39 × 27–36 μ. Acetabulum 45–61 μ in diameter, nearly equatorial. Holdfast organ longitudinally elongate or circular, 0.18–0.21 mm long, with median cleft, usually well apart from acetabulum. Testes at about middle of hindbody; anterior 0.1–0.11 × 0.125–0.21 mm, posterior 0.1–0.125 × 0.175–0.28 mm. Ovary 0.1 × 0.125–0.138 mm. Vitellaria extending to acetabulum. Eggs 84–96 × 57–68 μ.

*Renamed for *Proalaria mergi* Yamaguti, 1933, on p. 583 of part 3 of this series.

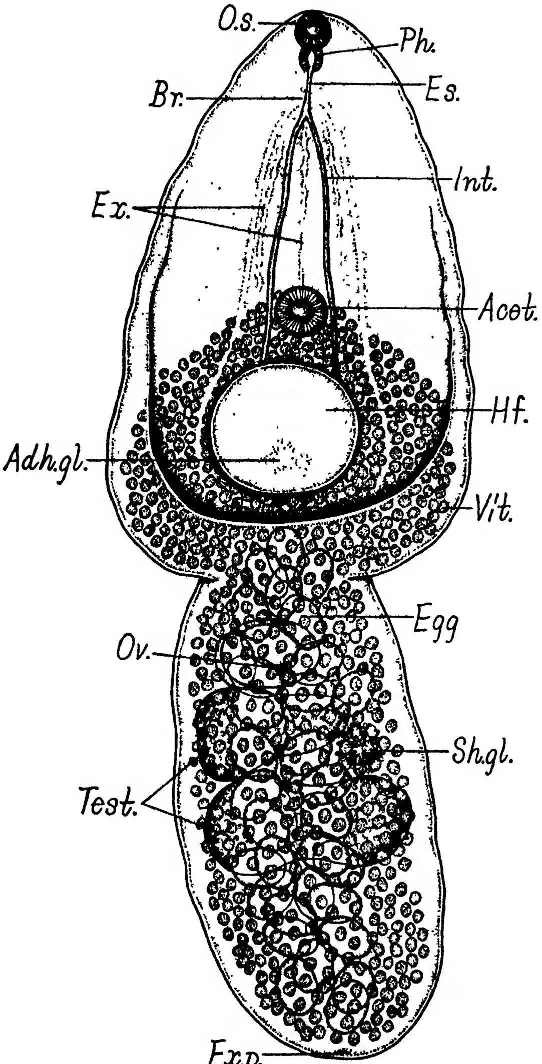

Fig. 14. *Neodiplostomum attenuatum* (von Linst., 1906); ventral view; 1.57 mm long.

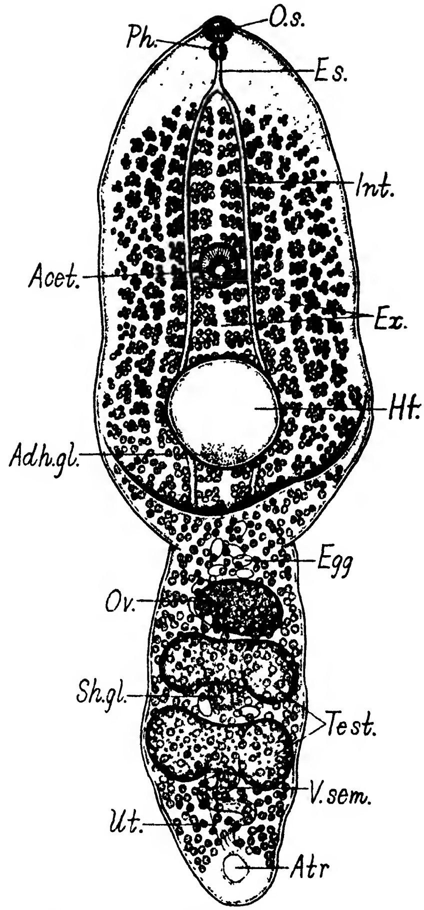

Fig. 15. *Neodiplostomum cochleare* (Krause, 1915); ventral view; 3.02 × 0.94 mm.

12. *Neodiplostomum cochleare* (Kause, 1915)

Four specimens of this worm were found in the small intestine of *Asio otus otus* (Linn.) from an unknown locality. Since Krause described this species in considerable detail, I will give here only a few important data to justify my identification.

The worms as fixed in alcohol in a relaxed state are 2.6–3.02 mm long,

the forebody being 1.63–1.77 × 0.84–0.94 mm and the hindbody 1.0–1.25 × 0.4–0.52 mm. The oral sucker is 78–84 × 90–96 μ and the pharynx 54–60 × 54–66 μ. The acetabulum, 135–138 × 144–153 μ, lies at or just in front of the junction of the anterior with the middle third of the body. The holdfast organ, 0.31–0.37 × 0.28–0.35 mm, is approximately one third the breadth of the forebody at the same level, so that it is definitely smaller relatively to the forebody than in *Neodiplostomum pseudattenuatum* (Dubois, 1927), to which the present species is closely allied. The transversely elongated, horse-shoe-shaped testes occupy the entire breadth of the hindbody; the anterior measures 0.18–0.21 × 0.36–0.43 mm and the posterior 0.2–0.26 × 0.32–0.48 mm. The oval ovary is 0.15–0.16 mm long by 0.22–0.25 mm broad. The vitellaria may extend a little farther forward than halfway between the two suckers. The genital atrium, about 0.12–0.13 mm wide, opens on the dorsal surface near the posterior end of the body. The eggs measured 96 × 54–60 μ in life. The very conspicuous median excretory stem extends from behind the intestinal bifurcation to the posterior end of the forebody.

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Dubois, G. Descriptions de nouveaux trématodes d'oiseaux du genre "Hemistomum". Bull. Soc. Neuchât. Sci. Nat., n. s., T. 1, 1927, p. 33–36.

Krause, R. Beitrag zur Kenntnis der Hemistominen. Zeitschr. Wiss. Zool., Bd. 112, 1915, p. 163–179.

von Linstow, O. Neue und bekannte Helminthen. Zool. Jahrb., Syst., Bd 24, 1907, p. 11–12.

13. *Allodiplostomum scolopacis* n. g. n. sp.

Description. Only four specimens of this worm were found in the small intestine of *Scolopax rusticola* Linn. They are so characteristic in shape that they are easily recognized with a hand lens. The dorsally convex and ventrally concave forebody is flexed dorsad at right angles to the approximately cylindrical hindbody, the former being 0.9–1.0 mm and the latter 1.0–1.7 mm in length. The subterminal oral sucker is 70–90 μ in diameter. There is a very short prepharynx. The spherical pharynx is 36–50 μ in diameter. The digestive system could not be made out with certainty. The acetabulum, 0.125–0.175 mm in diameter, lies at the base of the ventral concavity of the forebody just in front of the holdfast organ. The latter projects prominently near the posterior end of the forebody and consists of three massive lobes, two lateral and one posteromedian, connected with each other at the base, each having an incision at the middle of the margin; so that it has a definite cavity opening ventrally as well as anteriorly. On either side of the oral sucker there is a conspicuous depression surrounded by a dense mass of gland cells. The well developed dorsolateral muscle fibers originating from these depressions are attached to the dorsal wall of the anterior part of the hindbody, as in *Pulvinifer singularis* mihi. There are numerous large gland cells scattered in the parenchyma of the forebody.

The two testes, concave on the ventral side, are situated tandem in the middle third of the hindbody or a little farther behind; the anterior, 0.15–0.28 mm long, tapers toward the right and is contricted on the ventral side; the horse-shoe-shaped posterior, 0.15–0.26 × 0.38–0.5 mm, extends across the entire breadth of the hindbody. Each vas efferens is enlarged on the anterodorsal side of the corresponding testis, the anterior being immediately posterodextral to the ovary. The vesicula seminalis describes an S-shaped turn directly behind the posterior testis. The ductus ejaculatorius joins the uterus and forms a hermaphroditic duct, which turns anterodorsad at the posterior end of the body to open into the dorsal genital bursa on the top of a flat papilliform prominence.

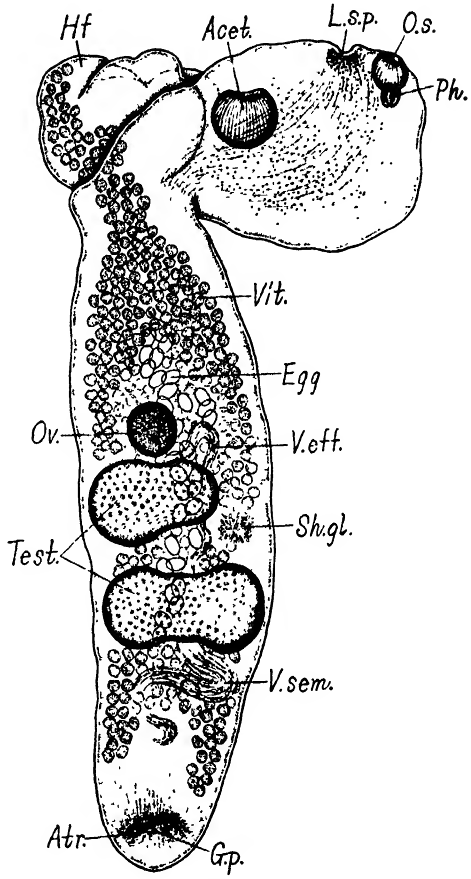

Fig. 16. *Allodiplostomum scolopacis*; Type; forebody 0.96 mm long in lateral view; hindbody 1.68 mm long in dorsal view.

The spherical ovary, 0.11–0.18 mm in diameter, lies almost in the median line or slightly to the side of the anterior testis. The compact shell gland lies opposite the anterior testis and a little behind it. The relatively large vitelline follicles extend into the median lobe of the holdfast organ; in the hindbody they occupy all the available space in front of, ventral to and behind the genital organs, leaving the extreme posterior end of the body free of them. The conspicuous vitelline reservoir lies directly in front of the posterior testis. The uterus extends a little anteriorly to the ovary or, when fully gravid, to near the anterior end of the hindbody. The oval, light brown, thick-shelled eggs are 69–75 × 49–51 μ; the contained ova are not segmented.

The excretory system is strongly developed on the dorsal side of the body, so that the latter appears very transparent.

Discussion. This worm is characterized by the body shape and the holdfast organ. In the anatomy of genitalia it is allied to *Diplostomum* v. Nordm., 1832, or *Neodiplostomum* Railliet, 1919, and its holdfast organ shows an intermediate stage of development between Diplostominae and Alariinae. If the lateral and posterior parts of the holdfast organ of *Diplostomum* were elongated dorsoventrally, the median cleft of the organ would become naturally more and

more pronounced and lead necessarily to the condition seen in the present species. In view of these considerations my worm should represent a distinct genus of Diplostominae.

Allodiplostomum n. g.

Generic Diagnosis. Strigeidae Railliet, 1919; Diplostominae Montic., 1892. Forebody strongly reflexed, convex dorsally but concave ventrally. Hindbody longer than forebody, nearly cylindrical. Lateral suctorial depressions present. Holdfast organ near posterior end of forebody, consisting of three lobes, two lateral and one posteromedian, connected with each other at base and each indented at middle of free margin. Testes tandem, at middle of hindbody or a little farther behind; anterior for most part on the side opposite shell gland, posterior across entire breadth of body. Ovary median or submedian (on side of anterior testis). Shell gland lateral. Vitellaria intruding into holdfast organ. Uterus extending a little anteriorly to ovary or to near anterior end of hindbody. Eggs oval, not very numerous, thick-shelled, light brown; contained ova not segmented. Excretory system well developed. Parasitic in birds.

Genotype. *Allodiplostomum scolopacis.*

Allodiplostomum scolopacis n. sp.

Specific Diagnosis. *Allodiplostomum* mihi; with generic characters. Forebody 0.9–1.0 mm long, hindbody 1.0–1.7 mm long, with maximum breadth of 0.5 mm. Oral sucker 70–90 μ in diameter. Pharynx 36–50 μ in diameter. Acetabulum 0.125–0.175 mm across. Anterior testis 0.15–0.28 mm long, posterior 0.15–0.26 × 0.38–0.5 mm. Ovary 0.11–0.18 mm in diameter. Eggs 69–75 × 49–51 μ.

Habitat. Small intestine of *Scolopax rusticola.*

Locality and date. Simane Prefecture; Jan. 12, 1934.

Type and paratypes in my collection.

14. *Strigea elongata* n. sp.

Description. Several specimens from the small intestine of *Accipiter virgatus gularis* (Temm. et Schl.). They were fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam. The forebody is 0.77–0.83 mm long by 0.45–0.6 mm thick; the elongate hindbody is attenuated in front and measures 3.25–4.0 mm long by 0.5–0.6 mm thick. The terminal oral sucker is 0.08–0.14 × 0.11–0.16 mm and the pharynx 0.096–0.12 × 0.078–0.11 mm. The esophagus is short. The simple ceca terminate at the sucker-like genital ring (Ringnapf). The acetabulum is 0.16–0.23 mm in diameter. The well developed lateral suctorial depressions give rise to strong dorsolateral muscle fibers extending into the hindbody. The two lobes of the holdfast organ may project over the rim of the forebody. The lobulate adhesive gland is 0.13–0.18 mm long by 0.23–0.25 mm broad.

The testes, 0.425–0.7 mm long by 0.35–0.5 mm thick, have a deep median furrow on the ventral surface; the anterior one lies just behind the middle of the hindbody. The vesicula seminalis is convoluted on the posterodorsal side of the posterior testis.

The ovary, 0.25–0.28 mm long by 0.23–0.26 mm thick, has on the posterior border a median indentation clearly recognizable in dorsoventral view, and

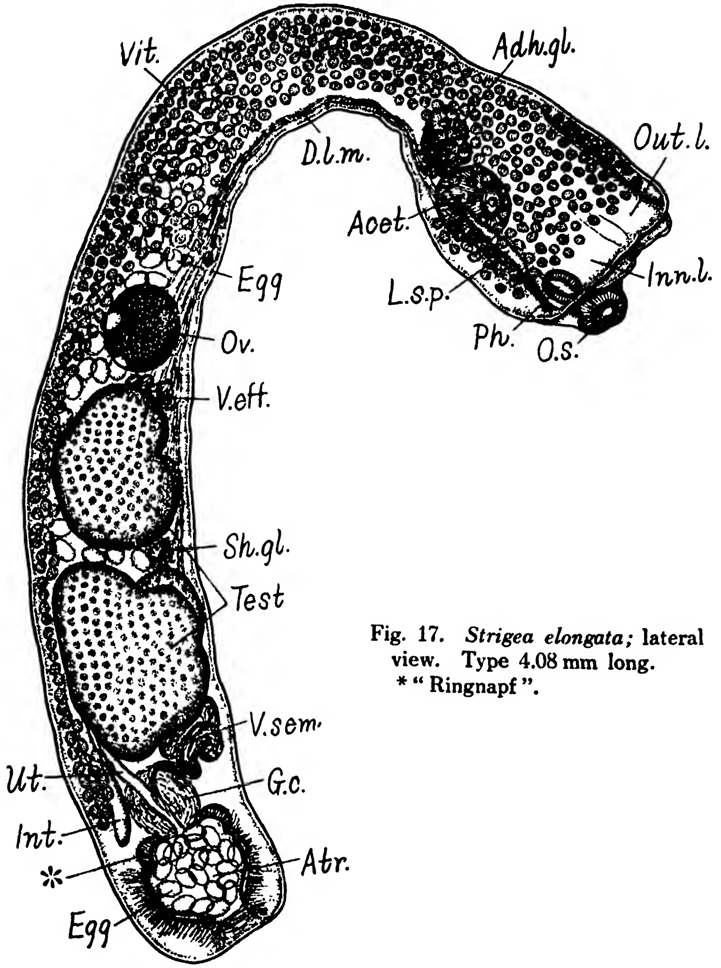

Fig. 17. *Strigea elongata;* lateral view. Type 4.08 mm long. * " Ringnapf ".

lies in the anterior part of the middle third of the hindbody. The shell gland complex is situated dorsally between the two testes. The vitellaria extending into the forebody stop short of the anterior rim on the ventral side but reach to the level of the pharynx on the dorsal side; in the hindbody they occupy the entire available space in front of the ovary as well as the postovarian ventral area as far as the genital cone. The uterus may extend to near the middle of the anterior third of the hindbody. The oval, light brown eggs are $87–96 \times 63–69\ \mu$; the contained ova are not segmented.

The muscular cone enclosing the terminal genital ducts is about 0.2 mm in diameter, and may project into the spacious genital bursa 0.23–0.36 mm wide. The sucker-like genital ring (Ringnapf) is 0.27–0.35 mm broad. There are very conspicuous excretory reservoirs on the dorsal side of the hindbody and around the genital cone.

DISCUSSION. This species is characterized by the body shape and the

position of the reproductive organs. In these respects it stands between *Strigea falconis* Szidat, 1929, and *Holostomum tenuicolle* Westr. of Szidat.

Strigea elongata n. sp.

SPECIFIC DIAGNOSIS. *Strigea* Abildg., 1793, as defined by Szidat. Forebody 0.77–0.83 × 0.45–0.6 mm; hindbody 3.25–4.0 × 0.5–0.6 mm, attenuated in front. Oral sucker 0.08–0.14 × 0.11–0.16 mm. Pharynx 0.096–0.12 × 0.078–0.11 mm. Acetabulum 0.16–0.23 mm in diameter. Testes 0.425–0.7 mm long by 0.35–0.5 mm thick; anterior testis just behind middle of hindbody. Ovary 0.25–0.28 mm long by 0.23–0.26 mm thick, in anterior part of middle third of body. Uterus extending forward to near middle of anterior third of hindbody. Eggs 87–96 × 63–69 μ.

Habitat. Small intestine of *Accipiter virgatus gularis* (Temm. et Schl.).

Locality and date. Unknown; Jan. 30, 1934.

Type and paratypes in my collection.

LITERATURE CITED

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ABBREVIATIONS USED IN FIGURES

Acet. acetabulum
Adh. gl. adhesive gland
Atr. genital atrium
Br. cephalic ganglion
Cirr. cirrus
Cirr. p. cirrus pouch
C. sp. collar spine
D. ej. ductus ejaculatorius
D. l. m. dorsolateral muscle
Es. esophagus
Ex. p. excretory pore
G. c. genital cone
G. d. germiduct
Gl. c. gland cell
G. p. genital pore
Hf. holdfast organ
Inn. l. inner lobe
Int. intestine
L. c. Laurer's canal
L. s. p. lateral suctorial pocket
Metr. metraterm
Mirac. miracidium
O. s. oral sucker
Out. l. outer lobe
Ov. ovary
Ph. pharynx
P. ph. prepharynx
Pr. c. prostatic cell
R. sem. receptaculum seminis
R. s. ut. receptaculum seminis uterinum
Sh. gl. shell gland
Test. testis
Ut. uterus
V. def. vas deferens
V. eff. vas efferens
V. sem. vesicula seminalis
V. s. ext. vesicula seminalis externa
V. s. int. vesicula seminalis interna
Vit. vitelline gland
Vit. d. vitelline duct
Vit. res. vitelline reservoir

6. Studies on the Helminth Fauna of Japan
Part 6. Cestodes of Birds, I

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Laboratory of Parasitology, Kyôto Imperial University

CONTENTS

INTRODUCTION

The 32 avian cestodes here described belong to 8 families, of which the Hymenolepididae has the largest generic as well as specific representation. Twenty two of them are new to science, the others being partly cosmopolitan and partly known from the Northern Hemisphere only. Ten species from Formosan birds were obtained by Mr. Ukyô Ô, to whom I wish to express my thanks here.

TETRABOTHRIIDAE Fuhrmann, 1908, nec Linton, 1889

1. *Tetrabothrius lari* n. sp.

DESCRIPTION. A number of this worm were obtained from the small intestine of *Larus canus major* Midd. at Kuki, Mie Prefecture. The type is 255 mm long by 1.41 mm broad and has 675 segments. The longitudinally elongated suckers are 0.3 mm long by 0.04 mm thick, with fairly prominent auricular appendages. The neck is about 5.0 mm long. The proglottides are definitely broader than long, with salient posterior borders, though the gravid end segments, a little narrower than the preceding ones, are approximately quadrangular and measure 0.8–1.1 × 1.2–1.3 mm. There are two layers of inner longitudinal muscles: the outer in small bundles of 4–8 fibers and the inner

Fig. 1 Fig. 2

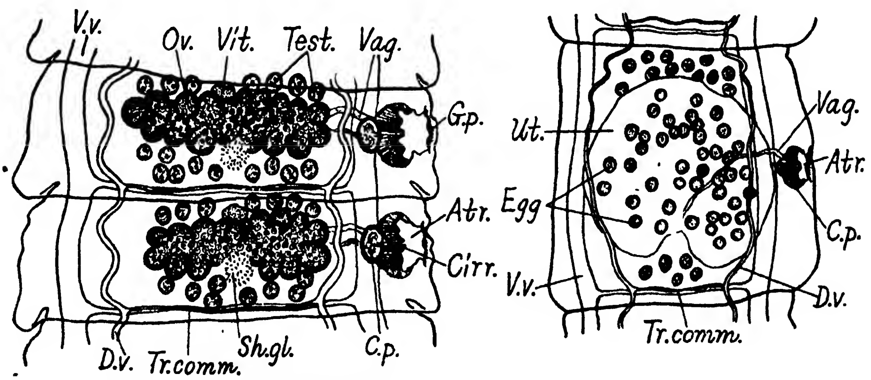

Fig. 1–2. *Tetrabothrius lari.*
Fig. 1. Mature segments 1.4 mm broad; dorsal view.
Fig. 2. Gravid segment 1.25 mm broad; dorsal view.

in strong bundles of as many as 70 fibers each; the bundles being separated from each other by a parenchymatous septum containing scanty dorsoventral muscle fibers. The thin layer of transverse muscles directly underlying the inner longitudinal bundles forms the outer boundary of the medulla.

The conspicuously sinuous dorsal and ventral excretory stems lie at about the middle of each lateral half of the proglottis, and are connected with their fellows of the opposite side at the posterior end of the proglottis, with the vas

deferens and vagina lying between. The nerve trunk passes lateral to the main excretory vessels mentioned above, and dorsal to the vas deferens and vagina on the pore side.

The globular testes are situated in two groups, one of 18–22 testes in front of the ovary and uterus, and the other of 11–17 behind them, the average total number being 34. They tend to atrophy in gravid segments, in which they may number only 12 in front and 6 behind. The vas deferens is very strongly convoluted. The somewhat laterally compressed cirrus pouch is 0.06–0.08 mm in longitudinal diameter, and contains a narrow convoluted ductus

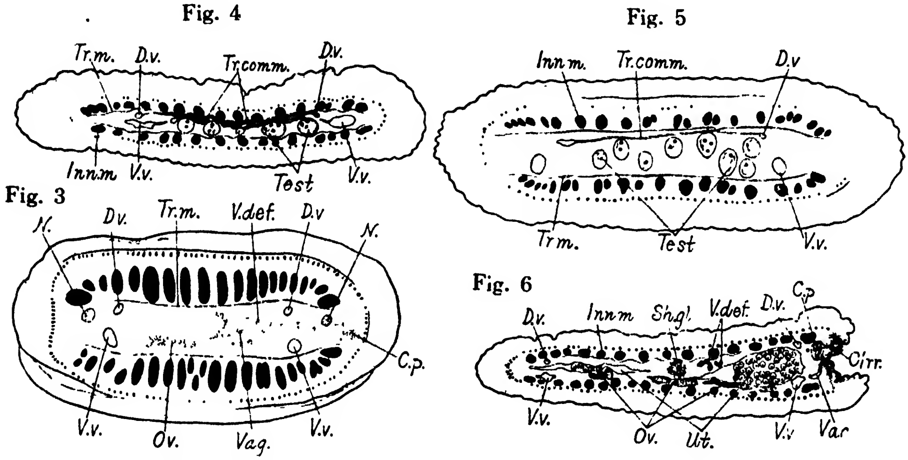

Fig. 3–6. *Tetrabothrius lari.*
Fig. 3. Transverse section of immature segment.
Fig. 4–5. Transverse sections of mature segment, showing dorsal excretory commissure.
Fig. 6. Transverse section of gravid segment at level of genital atrium.

ejaculatorius. The cirrus opens on the top of the small protrusible papilla at the dorsal part of the genital sucker, which measures about 0.14 mm antero-posteriorly. The spacious genital atrium opens at about the middle of the right margin of the proglottis or a little more behind. Some single or consecutive segments may exceptionally have their genital openings on the left margin.

The ovary which is transversely elongated and conspicuously lobulated all round lies a little nearer to the anterior border of the proglottis than to the posterior. The small compact, median vitelline gland is situated immediately in front of the ovary. The vagina opens into the genital sucker on the ventral side of the cirrus; it passes directly dorsal to the strong ventral muscular bundles and the ventral excretory stem, and then comes to lie dorsal to the ovary and uterus. The shell gland cells are closely massed around the germiduct in the median line posterodorsal to the ovary. The ootype is fairly conspicuous. The uterus is approximately inverted V-shaped with widely divergent arms, but when distended with eggs it becomes rounded with a deep posterior notch and may extend laterally beyond the excretory stems. The subglobular outer egg shells

are 48–72 × 45–69 μ, the onchospheres 39–54 × 36–48 μ, and the hooks 15–20 μ long.

DISCUSSION. This species is very closely related to *T. erostris* (Lönnberg, 1889) but differs from it distinctly in the size of eggs. In Lönnberg's original specimens the eggs are, according to Fuhrmann, only 0.027 mm in diameter.

Tetrabothrius lari n. sp.

SPECIFIC DIAGNOSIS. *Tetrabothrius* Rud., 1819; with generic characters given by Fuhrmann in 1908. Body length 255 mm or more, breadth 1.4 mm. Suckers 0.3 mm long by 0.04 mm thick, with fairly prominent auricular appendages. Neck about 5.0 mm long. Proglottides with salient posterior borders, definitely broader than long for greater part of strobila; gravid ones approximately quadrangular. Dorsal and ventral excretory commissures present. Testes in two groups, a preovarian of 18–22 and a postovarian of 11–17. Cirrus pouch more or less laterally compressed, 0.06–0.08 mm in longitudinal diameter. Cirrus opening on papilla dorsal to vaginal aperture. Ovary with lobulated borders, lying nearer to anterior border of proglottis than to posterior. Uterus approximately $\wedge$-shaped, but becoming rounded when distended with eggs, may extend laterally beyond excretory stems. Outermost egg shell 48–72 × 45–69 µ; onchospheres 39–54 × 36–48 µ; embryonic hooks 15–20 µ long.

Habitat. Small intestine of *Larus canus major* Midd.

Locality and date. Kuki, Mie Prefecture; March 23, 1927.

Type and paratypes in my collection.

LITERATURE CITED

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Fuhrmann, O. Die Cestoden der Vögel. Zool. Jahrb., Suppl. X, 1908, p. 32–33.

DAVAINEIDAE Fuhrmann, 1907

2. *Cotugnia meggitti* nom. nov. pro *C. cuneata* var. *nervosa* Meggitt, 1924

DESCRIPTION. This species was found in the small intestine of *Columba livia domestica* Linn. and *Streptopelia chinensis formosa* (Kuroda) from Formosa. The body is up to 44 mm in length and 3.4 mm in breadth at the last segment. The scolex, 0.4–0.56 mm broad, has an eversible apical depression (rostellum when everted) 0.2–0.38 mm broad, and four suckers 0.11–0.18 mm in diameter. The rostellar hooks about 18 μ long are arranged in two alternate rows and number approximately 300. There is a short neck about 0.25 mm long. The proglottides are definitely broader than long throughout the strobila and very thick, with salient posterior borders, giving rise to a conspicuously serrate appearance. The very strong inner longitudinal muscular bundles are separated by the transverse muscular lamellae into three or more layers decreasing in strength toward the cuticle. The wide ventral excretory stems of the two sides curve inwards at the posterior end of each segment to unite with each other by a transverse commissure. There is no dorsal excretory stem. The sinuous nerve cord accompanies the excretory stem on its outer side.

The testes, about 70 in number, form a continuous band in the posterior

Fig. 7

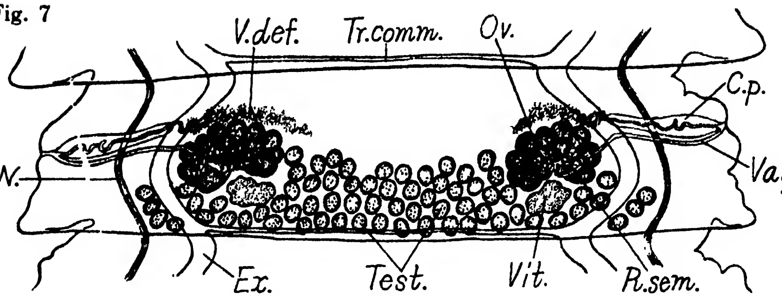

Fig. 8

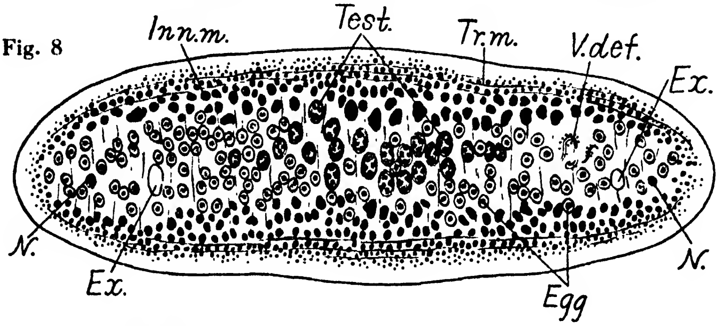

Fig. 7–8. *Cotugnia meggitti*.
Fig. 7. Mature segment 1.54 mm broad; dorsal view.
Fig. 8. Transverse section of gravid segment near its posterior end.

half of the proglottis between the nerve cords of the two sides. The coils of the vas deferens surrounded by gland cells lie dorsal to the excretory stem. The elongate cirrus pouch, 0.32 × 0.038 mm in a mature segment, reaches to the excretory stem. The narrow, convoluted cirrus opens with the vagina at the base of the prominent genital atrium, which in turn opens on either side at about the middle of the proglottis margin.

The multilobed crescentic ovary, 0.32 mm broad in a mature segment, lies directly inside the excretory stem. The compact vitelline gland, 0.1–0.11 mm broad, is situated just behind the ovary and a little medially to its hilus. There is a small, inconspicuous receptaculum seminis. The vagina runs transversely behind the cirrus pouch and curves forward to join the cirrus. The eggs are found not only in the medullary parenchyma but also in the spaces among the inner longitudinal muscular bundles; they have a thin large outer shell of varying size and a thicker embryonic shell surrounded by an amorphous vitelline substance and measuring 30–38 × 27–33 μ. The onchospheres are 24–30 × 21–24 μ and the embryonic hooks about 10 μ long. In sections the eggs appear to be enclosed in a deeply staining capsule, which is conspicuously thickened at the two poles.

Discussion. This worm is undoubtedly identical with ***Cotugnia cuneata*** var. ***nervosa*** Meggitt, 1924, but the latter being specifically distinct from ***C. cuneata*** var. ***tenuis*** I propose the name ***C. meggitti*** for it.

Cotugnia meggitti nom. nov.

SPECIFIC DIAGNOSIS. *Cotugnia* Diamare, 1893. Body length 60 mm, maximum breadth 3.0–3.4 mm. Scolex 0.4–0.56 mm. Rostellum 0.2–0.38 mm broad. Rostellar hooks about 18 μ long, in two rows. Neck short. Proglottides very thick, broader than long throughout, with three or more layers of strong inner longitudinal muscles. Testes about 70, continuous across median line. Cirrus pouch reaching to excretory stem. Genital pore equatorial. Embryonic shell 30–38×27–33 μ, onchospheres 24–30×21–24 μ. Parasitic in small intestine of pigeons.

3. *Cotugnia taiwanensis* n. sp.

DESCRIPTION. Several specimens from the small intestine of Formosan *Columba livia domestica*. The worm is so closely allied to *Cotugnia polyacantha* Fuhrmann, 1909, that a careful comparison is needed to distinguish the two.

	C. polyacantha Fuhrmann, 1909	*C. taiwanensis*
Breadth of scolex	0.45 mm	0.63–0.81 mm
Suckers	0.09 mm	0.15–0.18 mm
Diameter of rostellum	0.22 mm	0.28–0.42 mm
Length of rostellar hooks	10–12 μ	15–17 μ
Embryonic shell	30 μ	33–36×30–33 μ
Onchosphere	28 μ	24–27×22–27 μ

Fig. 9

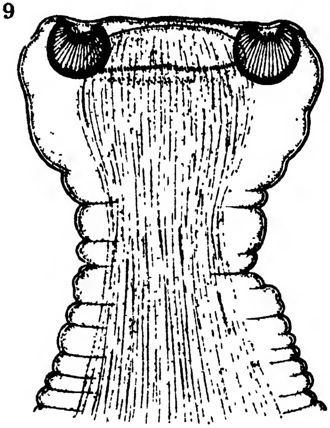

Fig. 11

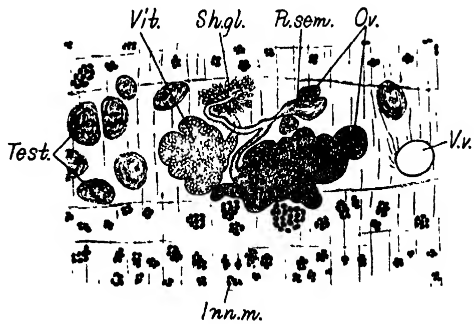

Fig. 10

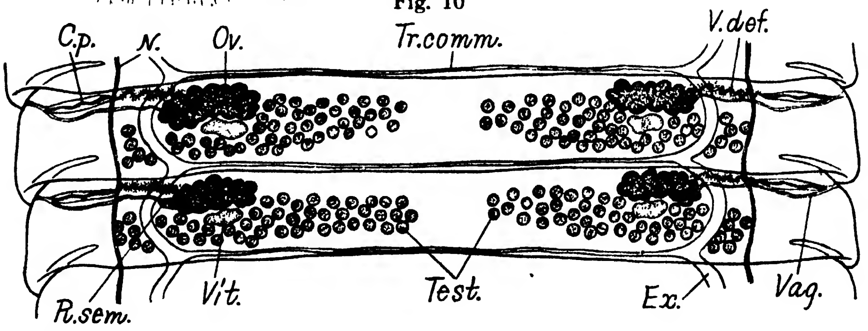

Fig. 9–11. *Cotugnia taiwanensis*.
Fig. 9. Scolex 0.75 mm broad; surficial view.
Fig. 10. Mature segments 2.5 mm broad; ventral view.
Fig. 11. Transverse section of mature segment showing ovarian complex.

Cotugnia taiwanensis n. sp.

SPECIFIC DIAGNOSIS. *Cotugnia* Diamare, 1893. Body 30×3 mm or larger. Scolex 0.63–0.81 mm broad. Rostellum 0.13–0.18 mm anteroposteriorly, 0.28–0.42 mm broad, 0.2–0.3 mm dorsoventrally, with more than 400 hooks 15–17 μ long. Suckers 0.15–0.18 mm in diameter. Neck 0.33–0.47 mm broad. Proglottides conspicuously imbricated; mature or gravid ones 8-9 times as broad as long. Testes about 50 on each side, interrupted in median field. Cirrus pouch elongate, 0.15-0.26 mm long, reaching to nerve cord but not to excretory stem. Coiled vas deferens surrounded by numerous large gland cells. Cirrus protrusible, slender. Genital pore just below posterolateral edge of preceding proglottis. Ovary multilobed, 0.2–0.27 mm broad. Vitelline gland slightly indented, about 0.15 mm broad, posteromedial to ovary. Vagina slightly dilated distally, surrounded by gland cells, covered inside by cilia. Receptaculum seminis elongate elliptical, 84×32 μ. Eggs intruding into longitudinal muscle layers; outer capsule 0.062–0.11×0.05–0.088 mm, embryonic shell 33–36×30–33 μ, onchospheres 24–27×22–27 μ, embryonic hooks about 10 μ long.

Habitat. Small intestine of *Columba livia domestica.*

Locality and date. Formosa; Jan. 3, 1934.

Type and paratypes in my collection.

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4. *Raillietina* (*Raillietina*) *pici* n. sp.

DESCRIPTION. A number of this worm were obtained from the small intestine of *Picus awokera awokera* Temm. by Dr. M. Yamazaki, who kindly gave me the entire lot for examination. The type is 36 mm in length, with a maximum breadth of 0.93 mm near the posterior end, and has 215 segments. The scolex, 0.33 mm broad, is not distinctly set off from the neck. The disc-shaped rostellum, 0.15 mm broad, bears a crown of minute hooks about 10 μ long, with a strongly recurved tip, and arranged in two alternate rows. The suckers, 0.1 mm in diameter, are armed with numerous hooklets 9 μ long and arranged in quincunx, with their pointed end directed toward the center of the sucker. The proglottides are broader than long throughout, and at the posterior end of the strobila, their salient posterior borders overlap the succeeding segments to a considerable extent.

The longitudinal muscles form a double layer, of which the outer is thicker and consists of more bundles than the inner. The transverse as well as the dorsoventral musculature is well developed. The thick-walled dorsal and thin-walled ventral excretory stems lie just inside the transverse muscle layer, about one third the breadth of the proglottis from the lateral margins or a little more laterally; the former are connected with each other by a transverse commissure at irregular intervals, but the latter only at the posterior end of each segment. The relatively thick nerve cord lies at each lateral edge of the medulla, ventral to the terminal genital ducts.

The testes, about 30 in number and confined to the intervascular field, are arranged in two or three layers on both sides of and behind the ovary. The strongly convoluted vas deferens passes near the anterior border of the

Fig. 12

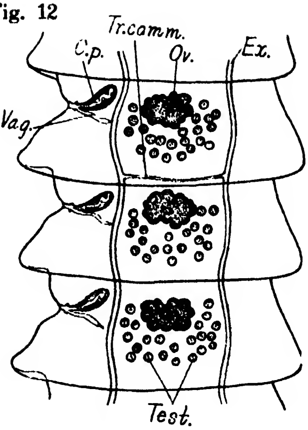

Fig. 14

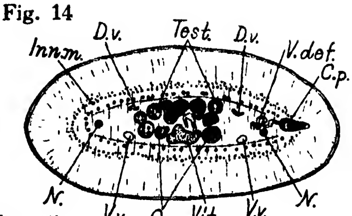

Fig. 15

Fig. 13

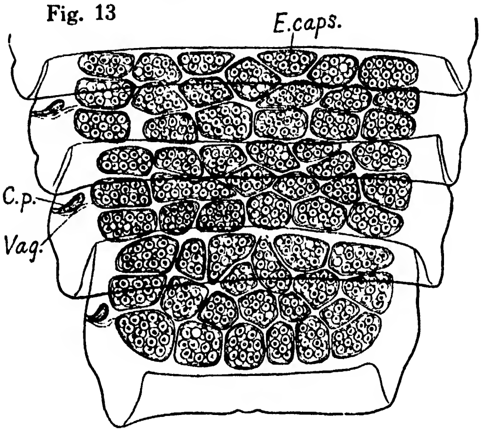

Fig. 16

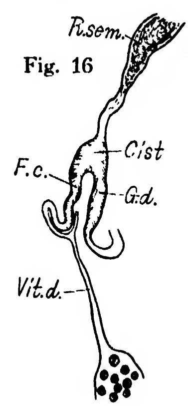

Fig. 12–16. *Raillietina (Raillietina) pici.*
Fig. 12. Immature segments 0.65 mm broad; ventral view.
Fig. 13. Gravid end segments 1.38 mm broad; ventral view.
Fig. 14. Transverse section of mature segment through vitelline gland.
Fig. 15. Transverse section of gravid segment at level of cirrus pouch.
Fig. 16. Complex of female genital ducts.

proglottis between the dorsal and the ventral excretory stems. The small pear-shaped cirrus pouch, 0.075×0.036 mm, has a thick muscular wall and contains a twisted ductus ejaculatorius at the base. The small protrusible cirrus is devoid of spines. The unilateral genital pores lie at about the middle of the proglottis.

When fully developed, the lobulated median ovary may extend as far laterally as the nerve trunk. Near the dorsal boundary of the medulla the germiduct unites with the short seminal duct to form a cistern, whence it proceeds ventrally and describes a small loop before joining the narrow straight vitelline duct originating from the posterior end of the vitelline gland (fig. 16). The compact vitelline gland lies directly posteroventral to the ovary. The vagina opens into the genital atrium immediately behind the cirrus, and has near its opening a small elongate saccular expansion thickly covered by hairs.

The transversely elongated, sinuous receptaculum seminis lies just inside the dorsal transverse muscle.

The egg capsules, about 20 in number for each gravid segment, are closely arranged in a single layer occupying the entire medulla, and contain each a dozen or more eggs. The eggs measure in water 45–57 × 30–45 μ, the onchospheres 20–24 × 15–20 μ, and the hooks 8 μ long.

DISCUSSION. The following comparative table shows clearly the differences by which the present species can be distinguished from the three members of the genus described from Piciformes.

	R. (*R.*) *frontina* (Duj., 1845) of Clerc, 1903	*R.* (*R.*) *lutzi* (Parona, 1901) of Fuhrm. 1908	*R.* (*R.*) *comitata* (Ransom, 1909)	*R. pici*
Rostellar hooks	14 μ	18–19 μ	11–13 μ (in a single row)	10 μ
Testes	50	?	30–35	ca. 30
Egg capsules	?	12–16	40–50	ca. 20
Eggs (outer shell)	93.6 × 60 μ	?	30–35 μ	45–57 × 30–45 μ

Raillietina (*Raillietina*) *pici* n. sp.

SPECIFIC DIAGNOSIS. *Raillietina* (*Raillietina*) Stiles et Orleman, 1926. Body 36 × 1.56 mm. Scolex 0.27–0.33 mm broad. Rostellum disc-shaped, 0.1–0.15 mm broad. Rostellar hooks about 10 μ long. Suckers about 0.1 mm in diameter. Testes about 30. Cirrus pouch 0.075 × 0.036 mm. Genital pore at about middle of proglottis. Egg capsules about 20 for each proglottis, containing each a dozen or more eggs. Outer shell of eggs 45–57 × 30–45 μ. Onchospheres 20–24 × 15–20 μ.

Habitat. Small intestine of *Picus awokera awokera*.

Locality and date. Nagano Prefecture; August, 1931.

Type and paratypes in my collection.

5. *Raillietina* (*Raillietina*) *galli* n. sp.

DESCRIPTION. This species was found in the small intestine of *Gallus domesticus* at Kuki, Mie Prefecture. It is 55 mm long by 1.25 mm broad. The scolex, 0.23–0.25 mm broad, passes gradually into the neck which is about 0.65 mm long and 0.16 mm broad at the attenuated anterior part. The bulbous rostellum, 0.036 × 0.03 mm, bears two alternate rows of hooklets about 6 μ long. The longitudinally elongate suckers, 0.11–0.15 × 0.057–0.063 mm, are armed with about a dozen rows of hooklets. The proglottides are broader than long, except the last which measures 1.2–1.4 × 1.25–1.58 mm, and their salient posterior borders more or less cover up the succeeding segments. The inner longitudinal musculature is well developed. The ventral excretory stems communicating with each other lie at the middle of the lateral third of the proglottis in the gravid portion, but more medially in the immature portion.

The testes, 28–32 in number, are arranged in one or two layers on either side of and behind the ovary, and may extend laterally beyond the antiporal ventral excretory stem. The vas deferens is strongly twisted in its proximal

Fig. 17

Fig. 18

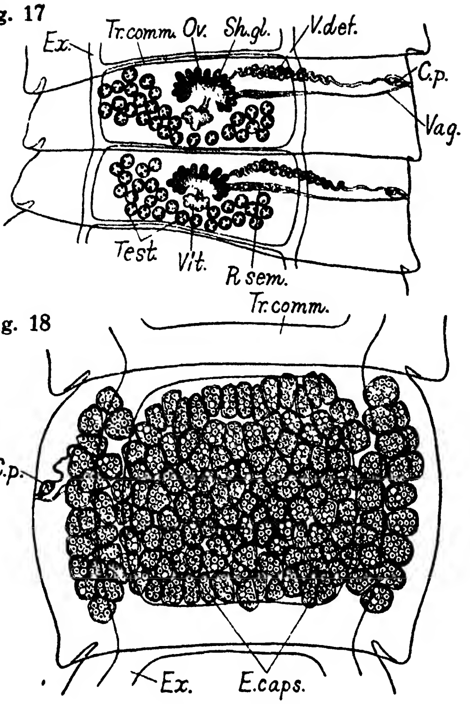

Fig. 17–18. *Raillietina* (*Raillietina*) *galli*.
Fig. 17. Mature segments 1.25 mm broad; ventral view.
Fig. 18. Gravid segment 2.1 mm broad; dorsal view.

half. The small, pear-shaped cirrus pouch, 0.048–0.08 × 0.033–0.05 mm, lies well apart from the excretory stem even in gravid segments, and contains at its base an S-shaped, more or less expanded ductus ejaculatorius. The unilateral genital pore lies at about the junction of the anterior with the middle third of the proglottis.

The median ovary is finely lobulated in the form of a rosette. The small compact vitelline gland lies immediately behind the ovary. The vagina opening directly behind the cirrus is slightly enlarged at its distal end for a distance of 0.06 mm and thickly covered by cuticular hairs. The tubular receptaculum seminis lies transversely just in front of the pore side testes. The uterus is split up into a number of tubular lobules which are sooner or later transformed into the egg capsules as the contained eggs mature. The egg capsules number up to 170 and are very closely arranged in a single layer, extending laterally beyond the ventral excretory stems; in some proglottides, however, they number only 50; each capsule contains 5–15 eggs, with the outer shell measuring 42–57 × 36–42 μ.

Discussion. This species resembles *Raillietina* (*Raillietina*) *tetragona* (Molin, 1858) Fuhrm., 1924, more closely than *echinobothrida* (Megnin, 1880), *volzi* (Fuhrmann, 1905), *penetrans* (Baczynska, 1913) or *cohni* (Baczynska, 1914), all described from *Gallus domesticus*, but differs from it distinctly in the position of the genital pore.

Raillietina (*Raillietina*) *galli* n. sp.

Specific Diagnosis. *Raillietina* (*Raillietina*) Stiles et Orleman, 1926. Body over 55 × 1.25 mm. Scolex 0.23–0.25 mm broad. Rostellum bulbous, about 0.036 × 0.03 mm. Rostellar hooks 6 μ long. Suckers 0.11–0.15 × 0.057–0.063 mm. Testes 28–32. Cirrus pouch 0.048–0.08 × 0.033–0.05 mm. Genital pore at about junction of anterior with middle third of proglottis. Egg capsules 50–170, containing each 5–15 eggs. Outer egg shell 42–57 × 36–42 μ.

Habitat. Small intestine of *Gallus domesticus*.

Locality and date. Kuki; March 28, 1927.

Type and paratypes in my collection.

6. *Raillietina* (*Raillietina*) *paucitesticulata* (Fuhrmann, 1908)

This species was first described by Fuhrmann and later by Joyeux and Houdemer, but their descriptions were unfortunately too brief and not accompanied by figure. The specimens on which the following supplementary description is based were collected in Formosa from the small intestine of *Oenopopelia tranquebarica humilis* (Temm.).

The worm is up to 160 mm long by 1.4 mm broad. The scolex is 0.08–0.12 mm broad. The suckers, 24–27 μ in diameter, bear small deciduous hooks about 8 μ long. The disc-shaped rostellum, 57 μ broad, is armed with a double circle of very closely set hooklets about 9 μ long. The neck and the ensuing portion of the strobila are nearly filiform. The proglottides with serrate lateral margins are broader than long throughout, the posterior gravid segments measuring 0.5–0.65 × 0.8–1.4 mm. The inner longitudinal muscles are well developed.

The oval to spherical testes, 0.04–0.06 mm in diameter, are 6–7 in number as in the specimens of Joyeux and Houdemer, two or three being on the pore side. The strongly twisted vas deferens surrounded by prostatic cells proceeds

Fig. 20 Fig. 19

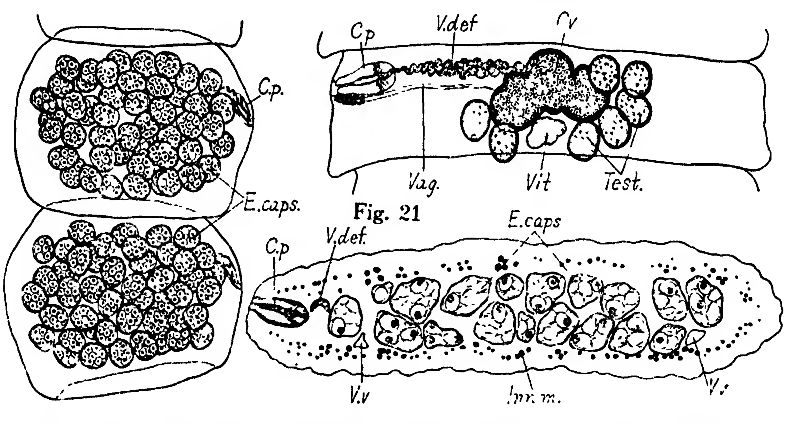

Fig. 19–21. *Raillietina* (*Raillietina*) *paucitesticulata* (Fuhrmann, 1908).
Fig. 19. Mature segment 0.5 mm broad; dorsal view.
Fig. 20. Gravid segments 0.87 mm broad; ventral view.
Fig. 21. Transverse section of gravid segment through cirrus pouch.

transversely near the anterior border of the proglottis. The elongate pear-shaped cirrus pouch, 0.08–0.2 × 0.05–0.075 mm, does not reach to the ventral excretory stem; it contains a short, somewhat enlarged ductus ejaculatorius and a protrusible cirrus covered by cuticular hairs. To the proximal end of the cirrus are attached short radial muscle fibers directed medially. The unilateral genital pore lies in front of or at about the middle of the proglottis margin.

The ventral ovary with an irregular outline develops into a large trans-

versely elongated organ. The small compact vitelline gland lies directly behind the ovary. The vagina opening directly behind the cirrus runs inwards along the posterior border of the cirrus pouch, surrounded by muscle fibers for about half the length of the latter. The receptaculum seminis is a somewhat sinuous tubular sac and lies behind the vas deferens. The egg capsules, 40–70 in number and containing each 5–12 eggs, occupy the entire medullary parenchyma, and when fully developed extend laterally beyond the ventral excretory stem on its dorsal side, as shown in fig. 21. The oval outer egg shell is 42–51 × 30–36 μ and the onchosphere 12–15 μ in diameter.

The wide ventral excretory stems lie about one sixth or one seventh the proglottis breadth from the lateral margins in gravid segments.

7. *Raillietina* (*Raillietina*) *taiwanensis* n. sp.

Description. A number of this worm were found in the small intestine of *Columba livia domestica* from Formosa. They are up to 170 mm in length and 1.8 mm in breadth. The scolex is 0.24–0.28 mm broad. The disc-shaped rostellum, 0.07–0.1 mm thick by 0.15–0.18 mm broad, bears about 200 hooks arranged in two alternate rows, those of the anterior row being a little longer and measuring 19 μ in length. The suckers, 0.06–0.084 mm in diameter, are bordered by several rows of minute hooks 8–10 μ long. The neck is 2–3 mm long and 0.2–0.28 mm broad just behind the scolex, from which it is not distinctly marked off. The proglottides have salient posterior borders and are broader than long throughout; the fully gravid ones are distinctly constricted

Fig. 22

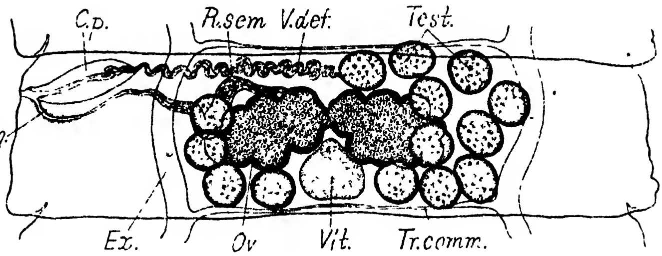

Fig. 24

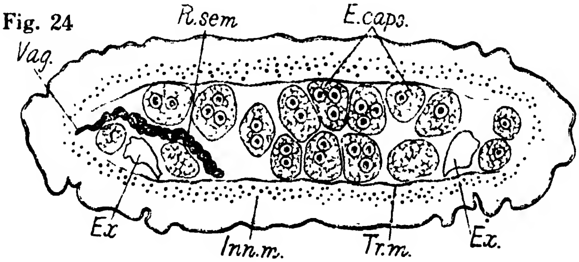

Fig. 23

Fig. 22–24. ***Raillietina* (*Raillietina*) *taiwanensis*.**
Fig. 22. Mature segment 0.77 mm broad; dorsal view.
Fig. 23. Rostellar hooklets about 19 μ long.
Fig. 24. Transverse section of gravid segment at level of receptaculum seminis.

from each other. The wide excretory stem lies ventral to the cirrus pouch and vagina, and has a transverse commissure at the posterior end of each segment.

There are 14–17 roundish testes, the majority occupying the entire length of the antiporal side of the proglottis, and the remaining 2–5 confined to the posterior angle of the medulla on the pore side. The elliptical cirrus pouch, 0.1–0.12 × 0.028–0.042 mm, contains at the base a sigmoid ductus ejaculatorius which may be slightly dilated to a vesicula seminalis interna; it does not reach to the excretory stem.

The spindle-shaped cirrus is lined by a spinose cuticle and has retractor muscular fibers attached to its proximal end. The cirrus unites with the vagina to form a short common duct opening on a papilla at the base of the genital atrium. The unilateral genital pore lies in front of the middle of the proglottis.

The coarsely lobed, bipartite ovary is about 0.11–0.13 mm long by 0.3–0.35 mm broad in mature segments. The globular median vitelline gland is 0.06–0.08 mm in diameter. The vagina opening directly behind the cirrus is surrounded by a muscular coat for a short distance at its arcuate distal end. The long, sinuous receptaculum seminis reaches across the excretory stem to the nerve cord. The egg capsules, about 60 in number and arranged in two or three layers, extend laterally beyond the excretory stem, and contain each 3–8 eggs measuring 36–42 μ in diameter in sections.

DISCUSSION. There have been recorded more than 20 species of *Raillietina* from Columbiformes, but *R. weissi* (Joyeux, 1923) is the only one in which the uterus extends beyond the excretory vessel; the new species differs from it in the number of rostellar hooks and testes.

Raillietina taiwanensis n. sp.

SPECIFIC DIAGNOSIS. *Raillietina* (*Raillietina*) Stiles et Orleman, 1926; with subgeneric characters. Body 170 × 1.8 mm or larger. Scolex 0.24–0.28 mm broad. Rostellum 0.07–0.1 × 0.15–0.18 mm. Rostellar hooks ca. 200 in number, 15–19 μ long. Suckers 0.06–0.084 mm in diameter, with several rows of hooks 8–10 μ long. Neck 2–3 × 0.2–0.28 mm. Proglottides broader than long throughout. Testes 14–17. Cirrus pouch 0.1–0.12 × 0.028–0.042 mm, not reaching to excretory stem. Ovary 0.11–0.13 × 0.3–0.35 mm. Vitellarium roundish, 0.06–0.08 mm across. Receptaculum seminis long and sinuous. Egg capsules ca. 60, extending laterally to excretory stem, containing each 3–8 eggs.

Habitat. Small intestine of *Columba livia domestica*.

Locality and date. Formosa; October 20, 1933.

Type and paratypes in my collection.

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ANOPLOCEPHALIDAE Kholodk., 1902

8. *Killigrewia oenopopeliae* n. sp.

DESCRIPTION. Two specimens of this species were found in the small intestine of *Oenopopelia tranquebarica humilis* from Formosa. The type is about 50 mm long and 4 mm broad for the greater posterior part; anteriorly it tapers rapidly. The scolex, 0.15 mm broad, bears four unarmed suckers which are 0.078 mm across and arranged in a dorsal and a ventral pair. The unsegmented neck region is short and only 0.11 mm broad. The proglottides are many times as broad as long and measure 0.37–0.56 × 4.0 mm in the posterior segments, whose transversely folded lateral borders are very prominent at the posterior edges. The thick inner longitudinal muscle sheath occupying the greater part of the cortex is composed of uniformly fine bundles. The

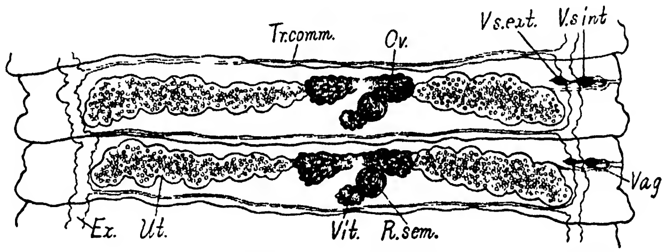

Fig. 25. Gravid segments of *Killigrewia oenopopeliae* 3.6 mm broad; ventral view.

transverse as well as the dorsoventral muscle fibers are strongly developed. The nerve cords and the excretory stems of the two sides lie close to the lateral margins of the strobila. There is a conspicuous transverse commissure between the ventral excretory stems.

The roundish to oval testes, 0.07–0.1 mm in diameter, are massed together into two groups lateral to the female reproductive organs, about 20 on the pore side and 30 on the other; some of them may overlap the lateral lobules of the ovary on the dorsal side. The small, elliptical, vesicula seminalis externa, about 0.075 × 0.05 mm, lies near the proximal end of the cirrus pouch. The latter is elongate pear-shaped, 0.23–0.25 × 0.05–0.075 mm, and reaches to the ventral excretory stem; it contains the vesicula seminalis interna at the base and a straight cirrus covered by cuticular hairs. The genital pores lie in the anterior third of the lateral margin of the proglottis, alternating irregularly from side to side.

The strongly lobulated bipartite ovary, 0.28 × 0.83 mm, lies in the ventral medulla a little nearer to the pore margin than to the other. The morula-like vitelline gland, 0.24 × 0.28 mm, is situated posterodorsal to the ovarial isthmus. The voluminous receptaculum seminis, 0.2–0.3 mm in diameter, lies ventrolateral to and a little in front of the vitellarium. The vagina opening directly posteroventral to the cirrus is covered by cuticular hairs at its distal end; it crosses the dorsal excretory stem on the ventral side and passes inwards

near the dorsal transverse musculature; it is fairly wide (0.03–0.05 mm) throughout, and somewhat sinuous in the proximal part. The uterus is at first a simple transverse tube, but as it develops it gives off backward and forward numerous pouches separated from each other by dorsoventral septa containing strong dorsoventral muscle fibers; it does not extend laterally beyond the excretory stems. The onchospheres, $30–33 \times 19–25\ \mu$, have two shells, of which the outer is delicate and measures $51–57 \times 39–42\ \mu$, while the elongate oval inner one is $39–44 \times 27–33\ \mu$. The embryonic hooks are $10–12\ \mu$ long.

The single paratype is 45 mm in length and 5 mm in maximum breadth at about the junction of the middle with the posterior third of the strobila.

DISCUSSION. This species differs notably from the related *Killigrewia frivola* Meggitt, 1927, in the number of testes and the size of eggs, and from *K. pamelae* Meggitt, 1927, in the breadth of the strobila and scolex, etc. I cannot agree with Fuhrmann in synonymizing *Killigrewia* Meggitt with *Aporina* Fuhrmann, because the type species of the latter has no genital pore, while that of the former has one; the extent of the uterus and testes is also different.

Killigrewia oenopopeliae n. sp.

SPECIFIC DIAGNOSIS. *Killigrewia* Meggitt, 1927. Body 50×5 mm or larger. Scolex about 0.15 mm broad; suckers 0.07–0.08 mm across. Neck short, 0.11 mm broad. Posterior proglottides $0.37–0.56 \times 4–5$ mm. Testes about 50, in two groups lateral to ovary. Cirrus pouch $0.23–0.25 \times 0.05–0.075$ mm, reaching to excretory stems. Cirrus and vagina covered by cuticular hairs. Genital pore in anterior half of proglottis margin. Ovary 0.83 mm broad or broader, strongly lobulated. Vitellarium finely acinous, 0.28 mm broad or broader. Receptaculum seminis very voluminous, 0.2–0.3 mm in diameter. Uterus with numerous anterior and posterior pouches, not extending laterally beyond excretory stems. Outer egg shell membranous, $51–57 \times 39–42\ \mu$; inner one $39–44 \times 27–33\ \mu$. Onchospheres $30–33 \times 19–25\ \mu$; embryonic hooks $10–12\ \mu$ long.

Habitat. Small intestine of *Oenopopelia tranquebarica humilis.*

Locality and date. Formosa; September 23, 1932.

Type and paratype in my collection.

9. *Killigrewia streptopeliae* n. sp.

DESCRIPTION. This worm was found in the intestine of *Streptopelia chinensis formosa* (Kuroda). It tapers rapidly toward the anterior extremity, while the greater part is nearly uniform in breadth, attaining a maximum of 5.5 mm at gravid segments. The proglottides have rather prominent posterior borders. The type, fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam, is 96 mm long by 3.66 mm broad and has 263 segments. The scolex is 0.2 mm broad at the level of the suckers, which are 0.075 mm in diameter and arranged in a dorsal and a ventral pair; it has a simple flat surface at the front end and no rostellum whatsoever. The neck is practically absent. The fully mature proglottides (fig. 27) are 0.52×3.66 mm, the gravid posterior ones (fig. 28) 0.96×3.25 mm, and the last 1.08×2.3 mm. In one paratype the fully gravid proglottides, about 0.6×5.1 mm, were very easily detached.

Fig. 26

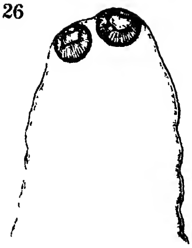

Fig. 29

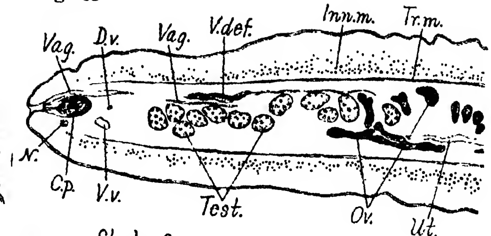

Fig. 27

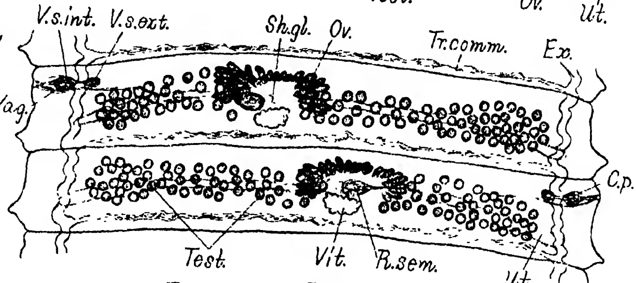

Fig. 28

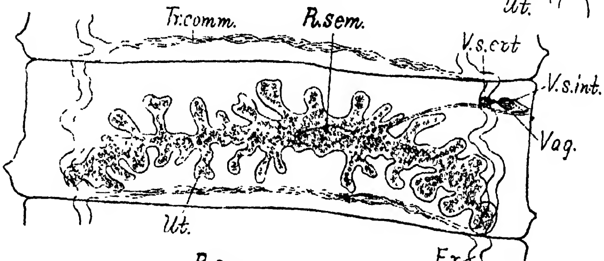

Fig. 30

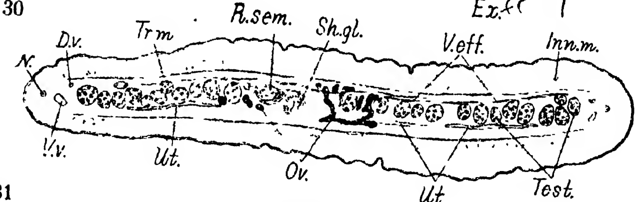

Fig. 31

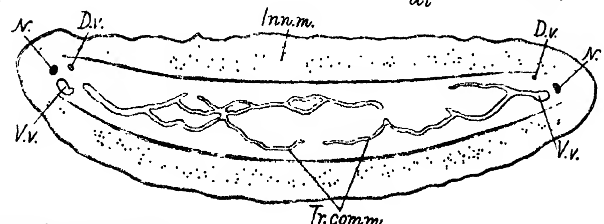

Fig. 26–31. *Killigrewia streptopeliae*.
Fig. 26. Scolex in dorsal view, 0.2 mm broad.
Fig. 27. Mature segments 3.66 mm broad; dorsal view.
Fig. 28. Gravid segment 3.25 mm broad; dorsal view.
Fig. 29. Transverse section of mature segment at level of genital pore.
Fig. 30. Same at level of receptaculum seminis.
Fig. 31. Transverse section of immature segment showing transverse excretory commissure.

The inner longitudinal muscular bundles increase in strength toward the very conspicuous transverse musculature delimiting the medulla. The narrow, thick-walled dorsal and the very wide, thin-walled ventral excretory stems lie ventral to the genital ducts near the lateral borders of the strobila, both pursuing a strongly sinuous course in the same sagittal plane. Though not pointed out by Meggitt, the transverse commissure of the ventral stems forms a very characteristic network at the posterior end of each segment, as shown in fig. 31. The nerve cord runs along each lateral edge of the medulla.

The testes, 70–120 in number and arranged in one or two layers between the excretory stems of the two sides, are separated by the female genital complex into two groups, 23–59 testes on the pore side and 29–62 on the other. It is worth noting that some testes intrude into the spaces among the ovarial lobules. The vasa efferentia pass on the dorsal side of the testes toward the pore margin of the proglottis. The vas deferens is simply sinuous, not coiled. The transversely elongated or globular vesicula seminalis externa, 0.06–0.11 mm in anteroposterior diameter in fully mature proglottides, lies just dorsal to the excretory stems. The club-shaped cirrus pouch, usually $0.2\text{–}0.25 \times 0.08\text{–}0.1$ mm, extends to or not quite to the excretory stems; its greater proximal part is occupied by the vesicula seminalis interna, which may occasionally be as large as 0.35×0.18 mm. The cirrus is beset with exceedingly fine cuticular hairs and opens on the ventral side of the vagina into the genital cloaca, which in turn opens at about the middle of the anterior half of the proglottis margin, alternating irregularly from side to side.

The bipartite ovary, 0.13×0.24 mm in the proglottides shown in fig. 29, consists of numerous finger-like lobules, the distal ends of which are directed for the most part dorsoventrally; it lies slightly on the pore side of the median line. The germiduct arising from the middle of the ovary proceeds dorsally to unite with the seminal duct from the receptaculum seminis; then it turns back on itself and enters the shell gland, which lies between the ovary and the vitelline gland, ventral to the antiporal end of the receptaculum seminis. The finely acinous vitelline gland, $0.11\text{–}0.2 \times 0.22\text{–}0.3$ mm, lies behind the ovary near the posterior end of the proglottis. The uterus begins as a simple, slightly arcuate tube passing directly ventral to the testes and reaching to the excretory stems near the origin of the transverse commissure; as it develops it gives off numerous dorsal outgrowths, which are elongated anteroposteriorly and may give off side branches as they become filled with eggs. In the last segment of the type, the stem of the uterus is approximately horse-shoe-shaped and strongly distended with eggs at the two ends. The eggs have a thin outer membrane and a thick embryonic shell surrounded by a vitelline membrane and measuring $30\text{–}33 \times 22\text{–}24\ \mu$. The onchospheres are $21\text{–}27 \times 18\text{–}20\ \mu$, and the hooks about $10\ \mu$ long. The vagina opening directly dorsal to the cirrus passes transversely on the dorsal side of the excretory stems and the testes, and forms on the posterodorsal side of the pore side half of the ovary a very large receptaculum seminis, which is more or less elongated transversely and measures 0.12–0.25 mm anteroposteriorly.

DISCUSSION. This species differs from the closely related *Killigrewia oenopopeliae* mihi in the number of testes as well as in the size of eggs, and from *Killigrewia frivola* Meggitt, 1927, chiefly in the number of testes.

Killigrewia streptopeliae n. sp.

SPECIFIC DIAGNOSIS. *Killigrewia* Meggitt, 1927; with generic characters. Body length 10 cm or more, breadth 5.5 mm. Scolex about 0.2 mm broad at level of suckers, with simple flat surface at its front end. Suckers 0.075 mm in diameter. Neck practically absent. Testes 70–120 for each proglottis, 23–59 on pore side, 29–62 on the other. Vesicula seminalis externa 0.06–0.11 mm across, just dorsal to excretory stems. Cirrus pouch usually 0.2–0.25 × 0.08–0.1 mm, reaching to excretory stems or not quite, its greater part occupied by vesicula seminalis interna. Cirrus beset with very fine cuticular hairs. Genital pore at about middle of anterior half of proglottis margin. Ovary up to 1.15 mm broad, strongly lobulated. Vitelline gland 0.11–0.2 × 0.22–0.3 mm. Receptaculum seminis very voluminous, more or less elongated transversely, measuring 0.12–0.25 mm anteroposteriorly, posterodorsal to pore side half of ovary. Embryonic shell 30–33 × 22–24 μ, onchospheres 21–27 × 18–20 μ, embryonic hooks about 10 μ long.

Habitat. Intestine of *Streptopelia chinensis formosa* (Kuroda).

Locality and date. Formosa; Dec. 31, 1933.

Type and paratypes in my collection.

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Fuhrmann, O. Les ténias des oiseaux, p. 58. Neuchâtel, 1932.

10. *Paronia pycnonoti* n. sp.

DESCRIPTION. The single specimen from the small intestine of *Pycnonotus sinensis formosae* is 55 mm in length and 2.5 mm in maximum breadth about 12 mm in front of the posterior end; it has 134 imbricate segments. The scolex 0.48 mm broad is slightly prominent at the apex. The suckers, 0.2 mm in diameter, are arranged in a dorsal and a ventral pair. The neck is about 0.7 mm long and 0.45 mm broad just behind the scolex. The gravid segments measure 0.52–0.65 × 1.47–2.5 mm. The inner longitudinal, transverse and dorsoventral muscles are strongly developed. The large ventral excretory stems of the two sides are connected with each other at the posterior end of each segment by an extraordinarily wide commissure, at the origin of which there is a conspicuous valve projecting posterolaterally. The narrow dorsal excretory stems are hardly recognizable. The nerve cord lies directly lateral to the ventral excretory stem.

The testes, about 80 in number, are arranged on the dorsal side of the medulla between the excretory stems of the two sides but interrupted by the female reproductive set. The vas deferens is convoluted at the proximal end of the cirrus pouch. The latter is elongate, 0.25–0.3 × 0.05 mm and extends obliquely anteromediad over the ventral excretory stem. The ductus ejacula-

Fig. 32

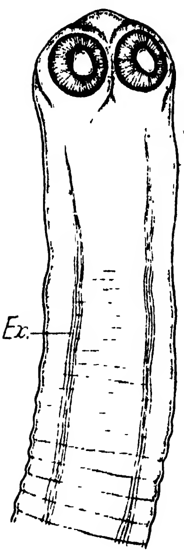

Fig. 33

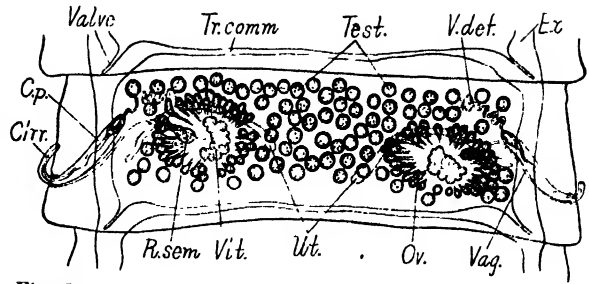

Fig. 34

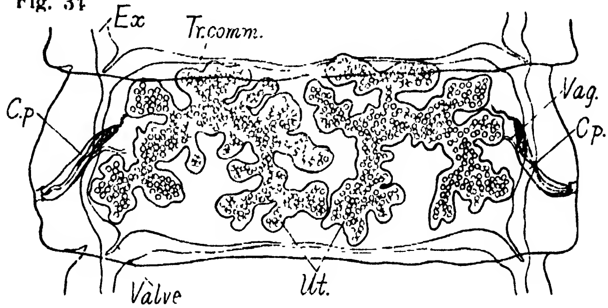

Fig. 32–34. *Paronia pycnonoti.*
Fig. 32. Scolex 0.48 mm broad; ventral view.
Fig. 33. Mature segment 1.87 mm broad; ventral view.
Fig. 34. Gravid segment 1.91 mm broad; ventral view.

torius forms a small seminal vesicle at the base of the cirrus pouch. The long, unarmed cirrus may attain a length of 0.3 mm when protruded. The marginal genital pore lies in the posterior half of the proglottis.

The rosette-shaped ovary, 0.3×0.45 mm in the mature segment figured, lies ventrally in each lateral half of the proglottis, enclosing a compact vitelline gland and a small fusiform or oval receptaculum seminis measuring 0.06×0.042 mm. The distal portion of the vagina runs along the posterior border of the cirrus pouch and opens into the genital atrium directly behind the cirrus. The uterus lying dorsal to the ovary begins as a simple arcuate tube with the concavity directed backward, but soon gives off a number of digitiform pouches, as shown in fig. 34; it does not fuse with its fellow of the opposite side even when distended with eggs. The globular, thin, outer egg shell, fixed in alcohol and measured in water, is 42–48 μ in diameter, and the innermost shell 21–27 μ long. The bean-shaped embryos are $18–21 \times 9–12\ \mu$.

DISCUSSION. This species bears a certain resemblance to *P. variabilis* (Fuhrmann, 1904), but differs from it in the characters of the testes and uterus. The specific diagnosis is reserved until additional specimens are available.

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DILEPIDIDAE Railliet et Henry, 1909

11. *Dilepis turdi* n. sp.

DESCRIPTION. Two gravid specimens of this tapeworm were found in the small intestine of *Turdus aureus aureus* from Aiti Prefecture. They measure 95 × 2.16 mm and 82 × 2.26 mm respectively. The scolex is about 0.4 mm broad. The prominent stout rostellum, 0.18 mm broad, bears two alternate rows of 40 spines 0.08–0.084 mm long. The suckers are about 0.18 mm in diameter. The neck is 0.5 mm long by 0.3 mm broad. The proglottides are broader than long throughout and have very salient posterior borders. The inner longitudinal muscle sheath forms a double layer. The transverse muscles are feebly developed except at the intersegments, where they form a very conspicuous layer. In the posterior segments, a very narrow dorsal and a very wide ventral excretory stems lie at about the middle of each lateral third of the strobila, ventral to the genital ducts. There is a ventral transverse commissure at each intersegment.

Fig. 35

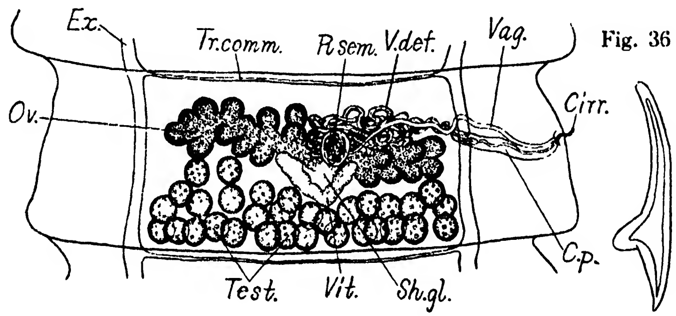


Fig. 36

Fig. 35–36. *Dilepis turdi.*
Fig. 35. Mature segment 1.35 mm broad; dorsal view.
Fig. 36. Rostellar hook 81 μ long.

The relatively large testes, 30–40 in number and 66–82 μ in diameter, are closely arranged in the medulla near the posterior end of the proglottis, between the excretory stems of the two sides. The wide vasa efferentia unite on the dorsal side into a strongly convoluted vas deferens, which lies near the anterior end of the proglottis. The extremely thin-walled, cylindrical cirrus pouch, about 0.25 mm long, contains a looped ductus ejaculatorius and a protrusible cirrus covered inside by very minute spines. The unilateral genital pore lies at about the middle of the proglottis margin.

The large acinous ovary occupies the greater part of the anterior half of the proglottis. The approximately V-shaped vitelline gland lies almost in the median line between the ovary and the testes. The spherical to elliptical or pear-shaped receptaculum seminis lies just in front and on the inner side of the pore side end of the vitelline gland. The somewhat sinuous vagina passes on the dorsal side of the vas deferens and then along the cirrus pouch, and opens

into the genital atrium directly in front of the cirrus; its distal end is surrounded by Begleitzellen for some distance. The gravid uterus occupies all the available space of the medulla. The ovoid eggs are 48–66 × 45–60 μ and the onchospheres 30–36 × 28–33 μ. The embryonic hooks are about 20 μ long.

DISCUSSION. This species resembles *Dilepis undulata* (Rud., 1810) of Volz (=*D. undula* Schrank), but differs from it chiefly in the size of the strobila, the number of rostellar hooks, etc. According to Volz the genital pores alternate irregularly in "*D. undulata*", with a tendency to lie on the left margin, but in my species they are constantly unilateral.

Dilepis turdi n. sp.

SPECIFIC DIAGNOSIS. *Dilepis* Weinland, 1858. Body 82–95 × 2.16–2.26 mm. Scolex about 0.4 mm broad. Rostellar hooks 40 in number, 80–84 μ long. Suckers about 0.18 mm in diameter. Neck about 0.5 × 0.3 mm. Gravid proglottides 4–5 times as broad as long. Testes 30–40 in number, 66–82 μ in diameter. Cirrus pouch cylindrical, about 0.25 mm long. Cirrus protrusible, armed with very minute spines. Genital pores nearly equatorial Ovary large, strongly lobulate, pretesticular. Vitelline gland V-shaped Receptaculum seminis slightly on pore side. Eggs 48–66 × 45–60 μ; onchospheres 30–36 × 28–33 μ; embryonic hooks about 20 μ long.

Habitat. Small intestine of *Turdus aureus aureus*.

Locality and date. Aiti Prefecture; November 20, 1933.

Type and paratype in my collection.

Fig. 37

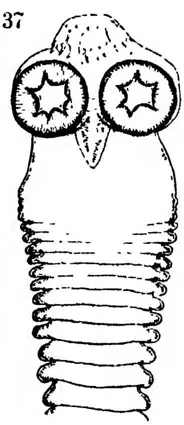


Fig. 38

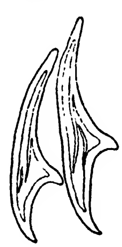


Fig. 37–40. *Dilepis capellae*.
Fig. 37. Scolex 0.25 mm broad; surficial view.
Fig. 38. Rostellar hooks from two rows, 54 μ and 61 μ long.
Fig. 39. Mature segment 0.91 mm broad; ventral view.
Fig. 40. Transverse section of mature segment through vitelline gland.

Fig. 39

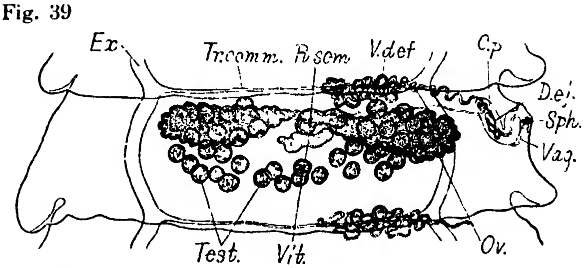
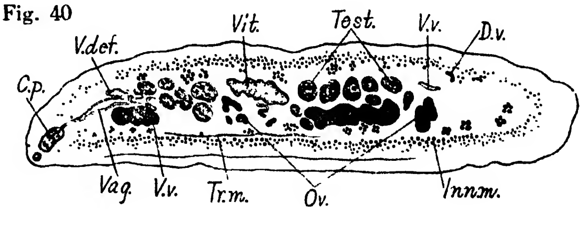


Fig. 40



12. *Dilepis capellae* n. sp.

DESCRIPTION. Several specimens from the small intestine of *Capella solitaria* (Hodgson). The body is up to 22 mm in length and 2.0 mm in maximum breadth. The scolex is 0.25–0.3 mm broad. The rostellum, about 0.19–0.2 mm long, bears 26 hooks arranged in two alternate rows at the enlarged anterior end, which is 88–96 μ broad. The anterior hooks are 57–65 μ long and the

posterior 48–54 μ long. The slender but strongly muscular posterior part of the rostellum is about 0.13 mm long and may occasionally reach to the posterior ends of the suckers. The thin-walled, spindle-shaped rostellar sac, about 0.09 mm broad, extends a short distance (42–54 μ) farther backwards than the posterior borders of the suckers, and contains on either side of the rostellum an elongated mass of gland cells, whose ducts appear to open outside at the junction of the rostellar sac with the bulbous anterior end of the rostellum mentioned above. The suckers are 0.1–0.12 mm in diameter. The neck is about 0.15 mm long and 0.2–0.23 mm broad. When contracted the imbricated proglottides assume a lamellar appearance and even when extended they are definitely broader than long; the gravid segments tend to decrease in breadth posteriorly.

The inner longitudinal muscles are greatly developed and their innermost bundles separated by the transverse muscle layer form a number of strong bands, of which the median are very conspicuous even in whole mounts. The ventral excretory stems curve inward at the posterior end of each segment to unite with each other by a transverse commissure; the stem of the pore side lies ventral to the vas deferens and vagina, while that of the other side lies on the dorsal side of the medulla.

The roundish testes, 36–40 in number, are situated on the dorsal side of the medulla between the excretory stems of the two sides, interrupted in the anterior median part. The vas deferens is strongly convoluted near the anterior border of the proglottis on the pore side. The cylindrical, curved cirrus pouch, about 0.12 mm long by 0.045 mm broad, contains a narrow convoluted ductus ejaculatorius. The plump cirrus, 24–38 μ broad, opens directly in front of the vagina into the genital atrium, which has a thick muscular wall surrounded by numerous subcuticular cells and opens at about the middle of the left margin of the proglottis. In contracted examples the genital atrium is more or less prominent and lies directly under the salient posterior border of the preceding segment.

The tubulo-acinous, bipartite ovary extends on the ventral side of the medulla as far as the excretory stems or a little farther outwards. The transversely elongated, lobulate vitelline gland is 0.1–0.16 mm broad and lies dorsally in the median line. There is a fairly large elongate receptaculum seminis at the proximal end of the vagina. The latter pursues a slightly wavy course on the postero-ventral side of the vas deferens and cirrus pouch, and at

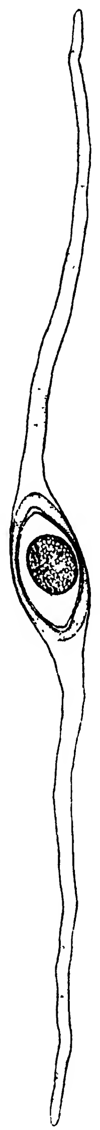


Fig. 41. Mature egg of *Dilepis capellae;* 24 μ broad.

its distal end turns abruptly forward to lead into the terminal enlargement with a sphincter. The uterus occupies the entire medullary parenchyma, leaving a small space for the receptaculum seminis. The thin outer egg shell is drawn out at each pole into a long filament, whose length could not be determined. The elliptical embryonic shell, slightly thickened at the two poles, measures 42–50 × 21–26 μ. The embryos are 24–30 × 17–23 μ and the hooks 12 μ long. The granular zone surrounding the embryonic shell may be absent occasionally.

DISCUSSION. So far as I am aware, there have been recorded from Scolopacidae five species of the genus *Dilepis*, i. e., *D. limosa* Fuhrmann, 1907, *D. nymphoides* Clerc, 1903, *D. ochropodis* Neslobinsky, 1911, *D. tringae* Cholodkovsky, 1913*, and *D.* sp. of Shen Tseng, 1932. My worm differs from the most closely related Shen Tseng's unnamed species chiefly in the number of testes and in the character of the outer egg shell.

Dilepis capellae n. sp.

SPECIFIC DIAGNOSIS. *Dilepis* Weinland, 1858. Body 22 × 2 mm or larger. Scolex 0.25-0.3 mm broad. Suckers 0.1–0.12 mm in diameter. Rostellum 0.19–0.2 mm long, 88–96 μ broad at its enlarged anterior end; rostellar hooks 26 in number, blade shorter than root; anterior hooks 57–65 μ long, posterior 48–54 μ long. Testes 36–40 in number. Cirrus pouch extending to near excretory stem but not beyond. Eggs with long polar filaments; embryonic shell elliptical, 42–50 × 21–26 μ; onchospheres 24–30 × 17–23 μ.

Habitat. Small intestine of *Capella solitaria* (Hodgson).

Locality and date. Loc. unknown; Dec. 29, 1933.

Type and paratypes in my collection.

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13. *Amoebotaenia oligorchis* n. sp.

DESCRIPTION. A number of this tapeworm were found in the small intestine of *Gallus domesticus*. The type, 1.54 × 0.67 mm, has 28 segments, of which the last contains no eggs, though fully mature. The scolex is 0.25 mm broad. The rostellum 0.15 mm long is divided into a cone-shaped anterior and a plump posterior portion, the former measuring 0.054 × 0.063 mm and the latter 0.096 × 0.057 mm. The hooks on the anterior portion of the rostellum

* This paper is inaccessible to me.

are 33 μ long and have just the same form as in *A. sphenoides* (Raill., 1892). The elliptical rostellar sac is 0.156 mm long by 0.09 mm broad. The suckers are 0.1 × 0.088 mm. The proglottides, much broader than long, gradually increase in breadth backwards and give the worm a wedge-like appearance. The last segment is 0.11 mm long by 0.67 mm broad. The inner longitudinal muscular bundles arising from the outer wall of the rostellar sac are well developed in the anterior part of the strobila, though they are split up into individual fibers in posterior segments.

Fig. 42

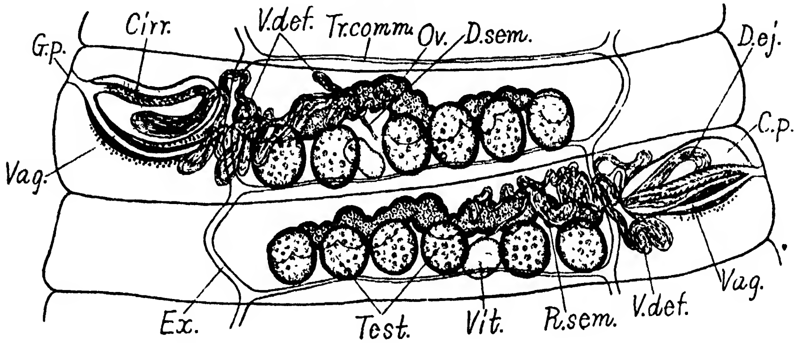

Fig. 43

Fig. 42–43 *Amoebotaenia oligorchis.*
Fig. 42. Mature segments 0.55 mm broad; dorsal view.
Fig. 43. Rostellar hooks 33 μ long.

The excretory system of each side consists of a very narrow dorsal and a wide ventral stem overlapping each other throughout their course; they pass on the ventral side of the vas deferens and vagina at the inner end of the cirrus pouch. At the posterior end of each proglottis the ventral stems of the two sides are connected by a transverse commissure lying ventral to the testes and vitellarium; the dorsal ones have no commissure.

The roundish testes, usually six in number, are spread transversely in the posterodorsal part of the proglottis between the excretory stems of the two sides. The vas deferens is strongly coiled at the proximal end of the cirrus pouch. The latter is plump, slightly curved and measures 0.08–0.108 × 0.039–0.042 mm; it contains a moderately wide looped ductus ejaculatorius, a straight cirrus lined by a thick corrugated cuticle and numerous Begleitzellen filling up all the available space. The cirrus opens directly in front of the vagina into the genital atrium which in turn opens at about the junction of the anterior with the middle third of the proglottis margin, alternating regularly from side to side.

The ovary with a zigzag outline is confined to the medulla ventral to the testes. The compact vitelline gland, about 0.042 mm in diameter in the last segment, lies between and slightly ventral to the second and third testis (numbered from the pore side). The vagina is provided for a distance of about 0.13 mm at its fairly wide distal portion, with strong longitudinal muscles

and a thick coat of gland cells, and this portion is connected by a short, very narrow, simple duct with the receptaculum seminis. The latter is a long, sinuous, tubular sac 0.015–0.025 mm wide, and lies directly dorsal to the pore side portion of the ovary.

The uterus and the eggs could not be observed.

VARIATIONS. The protrusible hook-bearing anterior portion of the rostellum may be rounded or rod-shaped according to the state of contraction. The rostellar hooks vary in length from 30 to 36 μ. The testes may number five in some proglottides and the vitelline gland may lie between the first and the second testis as numbered from the pore side.

DISCUSSION. This species conforms well to *A. sphenoides* (Railliet, 1892) in the characters of rostellar hooks, but differs from it chiefly in the number of testes and in the characters of the cirrus pouch, cirrus and vagina.

Amoebotaenia oligorchis n. sp.

SPECIFIC DIAGNOSIS. *Amoebotaenia* Cohn, 1899. Body 1.3–2.3 × 0.63–0.75 mm, consisting of 25–33 segments. Scolex 0.2–0.3 mm broad. Rostellum about 0.15 mm long, divided into a small protrusible, hook-bearing anterior and a larger posterior portion. Rostellar hooks 12 in number, 30–36 μ long. Suckers 0.1–0.15 × 0.08–0.125 mm. Posterior proglottides 4–7 times as broad as long. Testes usually 6 but sometimes 5 in number. Cirrus pouch plump, slightly curved, 0.08–0.135 × 0.036–0.045 mm. Cirrus lined by thick corrugated cuticle, opening directly in front of vagina. Genital pore about half as far removed from the anterior as from the posterior end of proglottis. Ovary confined to intervascular field. Receptaculum seminis tubular, long, sinuous. Distal part of vagina muscular, surrounded by gland cells. Eggs? Excretory stems at inner end of cirrus pouch, ventral to vas deferens and vagina.

Habitat. Small intestine of *Gallus domesticus*.

Locality and date. Kyoto; March 27, 1930.

Type and paratypes in my collection.

14. *Amoebotaenia sphenoides* (Railliet, 1892)

Since this fowl cestode has been described in detail by Meggitt and recently by Mönnig, I shall only submit data sufficient for identification. I found the worm associated with *A. oligorchis* (v. s.) in the upper portion of the small intestine of *Gallus domesticus* kept in my poultry yard. The specimen on which the following note is based was fixed in Schaudinn's solution with acetic acid added under a cover slip, stained with iron-hematoxylin and mounted in balsam. It is 1.38 mm long by 0.86 mm broad and has 19 segments. The scolex is 0.24 mm broad. The bottle-shaped rostellum, 0.15 × 0.06 mm, bears immediately behind its tip a crown of twelve hooks 32 μ long and with a long, very sharp blade. The elliptical, thin-walled rostellar sac is 0.18 mm long by 0.078 mm broad. The oval suckers are 0.114 × 0.09 mm.

The 12 testes forming a transverse row in the posterodorsal part of the proglottis, reach to the nerve trunks lying about 0.06 mm from the respective lateral margins in the posterior segments. The vas deferens is strongly coiled in the anterodorsal part of the pore side of the proglottis, and extends a little farther laterally than the inner end of the cirrus pouch, on its dorsal or ventral

side. The cylindrical, slightly undulating cirrus pouch measures 0.15 × 0.018 mm in the penultimate segment. The ductus ejaculatorius describes a loop reaching to near the distal end of the cirrus pouch. The narrow, protrusible cirrus opens directly in front of the vagina into the genital atrium surrounded by well developed muscular tissue. The marginal genital pore lies at the anterior third of the proglottis as stated by Cohn, alternating regularly from right to left, except that of the 14th segment which opens on the same side as the preceding.

The transversely elongated ovary with an irregular outline extends on the ventral side of the proglottis a little farther laterally on the pore side than on the other; it is 0.58 mm broad in the 16th segment measuring 0.86 mm in breadth. The compact vitelline gland, up to 0.036 mm long by 0.075 mm broad, lies ventral to the testes at the posterior end of the proglottis slightly to the pore side of the median line. The shell gland is distinctly recognizable between the ovary and the vitellarium. The receptaculum seminis is situated dorsal to the ovary on the pore side of the shell gland complex. The simple vagina passes ventral to the cirrus pouch and opens directly behind the cirrus as mentioned above. The uterus and the eggs could not be observed.

The dorsal and ventral excretory stems of the two sides pursue a characteristic serpentine course, overlapping each other. Meggitt states that the ventral vessels are much smaller than the dorsal and at times become so small that they appear to vanish, but he is undoubtedly in error, because the former are larger than the latter as usual. The two stems lie ventral to the vas deferens, vagina and testes but dorsal to the ovary. The transverse commissure of the ventral stems passes on the ventral side of the testes and vitellarium.

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Meggitt, F. J. On the anatomy of a fowl tapeworm, *Amoebotaenia sphenoides* von Linstow. Parasit. Vol. 7, No. 3, 1914, p. 262–277.

15. *Anomotaenia nycticoracis* n. sp.

Description. Large numbers of this cestode were obtained from the small intestine of *Nycticorax nycticorax nycticorax* shot at the Momoyama Imperial Mausoleum. They were fixed under slight cover glass pressure in Schaudinn's solution with acetic acid added. The largest specimen is about 14 mm in length and 0.8 mm in maximum breadth. The scolex, sharply marked off from the strobila, varies from 0.13 mm to 0.18 mm in breadth. The prominent retractile rostellum bears 20 hollow spines arranged in two alternating rows, those of the anterior circlet being 40–45 μ long, with a distally well-curved narrow blade 21–24 μ long and a relatively long root, and those of the posterior similarly shaped but 27–30 μ long. The rostellar sac is about 0.08 mm long when extended and equally broad when the rostellum is retracted; it extends a little farther backwards than the anterior borders of the suckers. The latter are 0.06–0.084 mm in diameter. The proglottides are broader than

long with the posterior borders projecting prominently, mature ones being 0.4–0.65 × 0.7–0.8 mm. The inner longitudinal muscle sheath consisting of comparatively fine bundles reaches to the cuticle at the anterior end of the segment. The fairly wide ventral and the very narrow dorsal excretory trunks are separated from each other on the pore side by the cirrus pouch and vagina; they curve more or less strongly inwards at the intersegments. Transverse commissures between the ventral stems of the two sides could not be definitely made out, though they may be present.

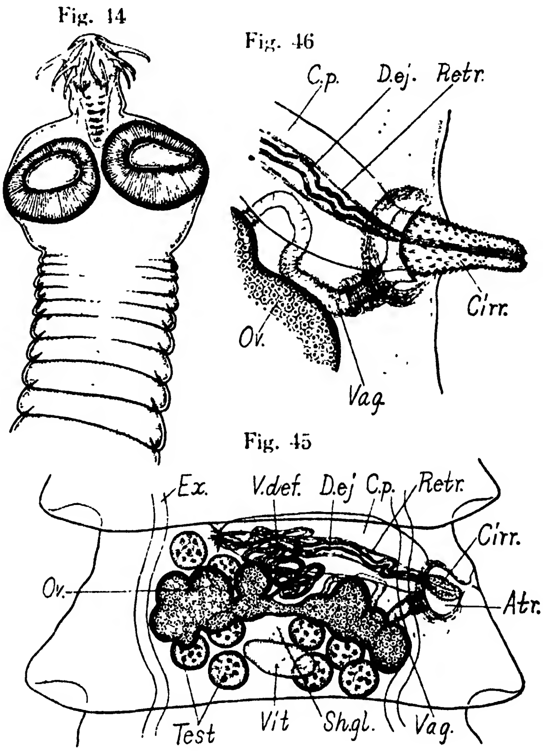

Fig. 44–46. *Anomotaenia nycticoracis.*
Fig. 44. Scolex 0.15 mm broad.
Fig. 45. Mature segment 0.58 mm broad; dorsal view.
Fig. 46. Male and female terminal genitalia; ventral view.

The roundish testes, 10–13 in number and measuring up to 0.06 mm in diameter, lie mostly behind the ovary and only a few dorsal or antero-dorsal to it on the antiporal side; in immature segments they are grouped around the female reproductive anlage. The vas deferens is strongly coiled dorsal to and behind the proximal end of the cirrus pouch. The elongate spindle-shaped, thin-walled cirrus pouch, 0.22–0.37 × 0.04–0.07 mm, lies obliquely to the longitudinal axis of the strobila, with its inner end at the anterior end of the proglottis extending a little beyond the median line. In fully mature segments it persists as a rather slender tubular structure not reaching to the median line. The narrow ductus ejaculatorius is convoluted in the proximal half of the cirrus pouch. There are very conspicuous retractor connecting the inner end of the cirrus with the base of the cirrus pouch. To the base of the cirrus pouch are also attached a number of short muscle fibers diverging toward the antiporal side. Numerous cells fill up the available space within the cirrus pouch. The everted cirrus is armed at its enlarged base with short stout spines which are about 10 μ long and arranged in quincunx, and with more densely set slender spines at its distal portion; it projects into the spacious genital atrium provided with radial and circular muscle fibers. This atrium, 0.06–0.08 mm longitudinally, opens outside in front

of the middle of the lateral margin of the proglottis, alternating irregularly from right to left.

The transversely elongated ovary is more or less digitate in outline and measures 0.14–0.22 × 0.33–0.62 mm; when fully developed it extends laterally to the excretory stems. The compact, ventral vitelline gland, about 0.05 × 0.075 mm, lies in the median line behind the ovary. The vagina opening posteroventral to the cirrus passes inwards in a sinuous course as a fairly wide tube covered inside by hair-like spines and surrounded by well developed circular muscle fibers; it may form a definite receptaculum seminis before leading into the narrow ductus seminalis. The uterus and eggs could not be observed.

DISCUSSION. Although the characters of the uterus and eggs are not known, this species evidently belongs to *Anomotaenia* Cohn, 1900. According to Fuhrmann, there have been described five species of the genus from Ardeiformes, viz., *papilla* (Wedl, 1855), *discoidea* (van Ben., 1868), *leuckarti* (Krabbe, 1869), *aurita* (Rud., 1819) and *asymmetrica* Johnston, 1911. The last one differs from mine chiefly in the number of testes, but since the others are unknown to me, I look upon my species as provisional.

Anomotaenia nycticoracis n. sp.

SPECIFIC DIAGNOSIS. *Anomotaenia* Cohn, 1900; with generic characters. Length about 14 mm, breadth 0.8 mm. Scolex 0.13–0.18 mm broad. Rostellar hooks 20; anterior 40–45 μ long, posterior 27–30 μ long. Rostellar sac extending a little farther backwards than anterior borders of suckers. Suckers 0.06–0.084 mm in diameter. Proglottides broader than long, with salient posterior borders. Testes 10–13 in number, mostly behind ovary. Cirrus pouch 0.22–0.37 × 0.04–0.07 mm, extending beyond median line. Everted cirrus armed with stout spines at base and with slender ones distally. Genital pore pre-equatorial. Ovary digitate, 0.14–0.22 × 0.33–0.62 mm. Vitellarium 0.05 × 0.075 mm. Vagina beset with hair-like spines. Egg?

Habitat. Small intestine of *Nycticorax nycticorax nycticorax*.

Locality and date. Kyoto; June 11, 1932.

Type and paratypes in my collection.

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HYMENOLEPIDIDAE Railliet et Henry, 1909

16. *Hymenolepis serpentulus* (Schrank, 1788) Cohn, 1901

Several gravid specimens up to 150 × 2.18 mm were found in the small intestine of *Corvus corone corone* Linné from the suburb of Kyoto. The scolex is 0.18 mm broad. The small subglobular rostellum, 0.05 mm in diameter, bears a single row of ten hooks about 24 μ long. The suckers are 75 μ in diameter. The neck is very long and filiform when relaxed. The imbricated gravid proglottides are 0.35–0.65 mm long by 1.3–2.18 mm broad. The inner longi-

tudinal muscle sheath is very strongly developed. Of the two antiporal testes the anterior is more or less lateral to the posterior. The voluminous vesicula seminalis externa overlaps the receptaculum seminis in front of the pore side testis. The greater proximal portion of the elongate cirrus pouch measuring 0.15 × 0.05 mm in a fully mature proglottis, is occupied by the vesicula seminalis interna. The genital pore lies on the right margin of the proglottis behind its middle. The compact vitellarium is up to 0.3 mm in diameter. The large pyriform seminal receptacle, 0.3–0.4 × 0.15–0.2 mm, lies on the pore side at the anterior end of the proglottis. The embryonic shell is 48–60 × 39–45 μ and the onchosphere 36–39 × 30–36 μ. The embryonic hooks are up to 24 μ long.

17. *Hymenolepis exigua* Yoshida, 1910

Fig. 47. Rostellar hook of *Hymenolepis exigua* Yoshida, 1910.

Although this species was described by Yoshida very accurately, I venture to make some remarks on its anatomy on the basis of my material obtained from *Gallus domesticus*.

According to Yoshida, the rostellar hooks are 0.03–0.05 mm long, but there is no such great variation as 20 μ in my specimens, in which they are 42–45 μ long and more slender than in Yoshida's figure. (Fig. 47.)

The long, undulating, tubular cirrus pouch may often extend to near the antiporal margin across the excretory stems of that side.

18. *Hymenolepis nyrocae* n. sp.

Description. Large numbers of this worm were found in the small intestine of *Nyroca* (*Fuligula*) *marila mariloides* (Vigors) and *Anas platyrhyncha platyrhyncha* from Lake Biwa. They were all mature but not yet gravid. The type is 24 mm long by 0.8 mm broad, somewhat attenuated at the posterior end and has 189 segments. The rounded scolex 0.11 mm broad is clearly set off from the neck region. The short rostellum is 0.036 mm broad and bears a single row of 16 hooks which are only 9 μ long and have a fairly long stout guard and a short slender root. The four prominent suckers are about 0.05 mm in diameter. The finely segmented anteriormost region is broader for a distance of about 0.3 mm, giving the worm a very characteristic appearance. The proglottides are definitely broader than long throughout and have a conspicuously serrate lateral margins; the mature ones measure 0.12–0.16 × 0.62–0.88 mm. The inner longitudinal muscular bundles are fairly well developed.

The three oval testes, 0.075–0.08 × 0.11–0.125 mm, form a transverse row, with the antiporal one a little in front of the others. The voluminous vesicula seminalis externa, 0.08–0.15 × 0.25–0.3 mm, lies directly dorsal to the proximal end of the cirrus pouch. The latter is elongate spindle-shaped, slightly sinuous and has a very muscular wall; it lies transversely near the anterior margin of

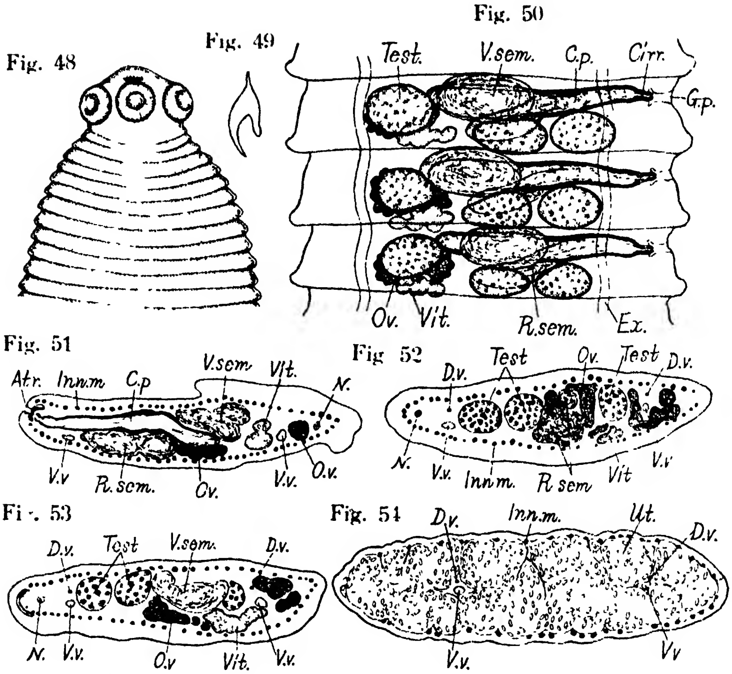

Fig. 48-54. *Hymenolepis nyrocae.*
Fig. 48. Scolex 0.11 mm broad.
Fig. 49. Rostellar hook 9 μ long.
Fig. 50. Mature segments 0.65 mm broad; dorsal view.
Fig. 51-53. Transverse sections of mature segment at three different levels.
Fig. 54. Transverse section of gravid segment.

the proglottis and when fully extended, may reach to the excretory stems of the antiporal side or a little farther; it is almost entirely occupied by the vesicular seminalis interna. The slender cirrus projects into the basally enlarged genital sinus at the top of a papilla covered by exceedingly minute spines. The unilateral genital pore lies just in front of the middle of the lateral border of the proglottis.

The strongly lobulated ovary lies on the antiporal side. The vitelline gland is a coarsely lobed, transversely elongated mass 0.16–0.2 mm broad; it lies on the antiporal side just inside the excretory trunks. The uterus divided into numerous compartments occupies all the available space of the medulla and when it is distended with eggs the cortical parenchyma becomes atrophied to a thin layer. The elliptical eggs fixed in alcohol measure in water 36–45 × 19–22 μ and are covered all over with very fine hairs; the somewhat elongate onchospheres are 18–24 × 10–11 μ. The vagina opens into the genital sinus directly ventral to the cirrus; its narrow distal portion lined by cuticle is slightly enlarged at the base and communicates by a hardly recognizable duct with the twisted receptaculum seminis, whose distal part lies ventral to the cirrus pouch.

The excretory system consists of a narrow thick-walled dorsal and a wide

thin-walled ventral vessel, both lying ventral to the cirrus pouch and vagina on the pore side but dorsal to the ovary on the other. They lie at about the middle of the lateral third of the proglottis, but a little nearer the median line in gravid segments, in which the ventral vessel runs just in the mid-transverse plane. The nerve cord lies inside the lateral edge of the inner longitudinal muscle sheath; on the pore side it passes ventral to the genital sinus.

DISCUSSION. This species is closely related to *H. meggitti* Tseng, 1932, but differs from it in the size of rostellar hooks.

Hymenolepis nyrocae n. sp.

SPECIFIC DIAGNOSIS. *Hymenolepis* Weinland, 1858; with generic characters. Body over 62×1.28 mm, with more than 300 segments. Scolex rounded, sharply set off from neck. Rostellum 0.06×0.036–0.042 mm, with a single crown of 16 hooks 9 μ long. Suckers about 0.05 mm in diameter. Anterior segmented part of strobila conspicuously broader. Proglottides definitely broader than long all through, with salient posterior borders. Testes in a transverse row, antiporal one slightly anterior to others Cirrus pouch elongate spindle-shaped, muscular, 0.57–0.66 mm long by 0.075–0.1 mm broad, may occasionally reach to antiporal excretory stems. Vesicula seminalis externa well developed. Cirrus slender, projecting into genital sinus at top of a papilla covered by exceedingly small spines. Genital pore pre-equatorial. Ovary on antiporal side. Vagina opening directly ventral to cirrus. Receptaculum seminis voluminous, twisted. Eggs 36–45×19–22 μ, thickly covered by very fine hairs; onchospheres elongate, 18–24×10–11 μ.

Habitat. Small intestine of *Nyroca* (*Fuligula*) *marila mariloides* (Vigors) (type host) and *Anas platyrhyncha platyrhyncha.*

Locality and dates. Lake Biwa; December 5, 1931 (type date); November 28, 1928.

Type and paratypes in my collection.

19. *Hymenolepis japonica* n. sp.

DESCRIPTION. A number of this worm were obtained from the small intestine of *Podiceps ruficollis japonicus.* They were mostly fixed under a cover slip in Schaudinn's solution with acetic acid added. The type, stretched when fixed, is more than 7 cm long and 0.77 mm in maximum breadth at the posterior gravid segments. The scolex is 0.2–0.24 mm broad. The rostellum, 0.075–0.1 × 0.08–0.09 mm, bears a crown of ten hooks which are 39–41 μ long and have the shape represented in fig. 56. The rostellar sac is 0.14–0.18 × 0.08–0.1 mm. The suckers are 0.06–0.08 mm in diameter. The proglottides are very closely crowded together, with salient posterior borders; the broadest gravid ones are about 7–8 times as broad as long in the much extended type.

Just inside the inner muscle sheath there are eight longitudinal muscle bands, four dorsal and four ventral; they consist of elongate spindle-shaped muscle fibers which are closely massed together but interrupted at various intervals; the stronger medial bands lie near the median line and the lateral ones outside the excretory stems.

The dorsal and ventral excretory stems lie about one third the width of the proglottis from the lateral margin, ventral to the cirrus pouch and vagina on the pore side. The nerve cord lies at about the middle of each lateral third of the proglottis, ventral to the cirrus pouch and vagina.

Fig. 55

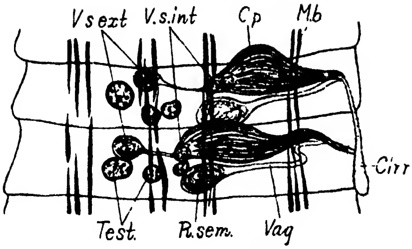

Fig. 56

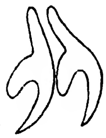

Fig. 57

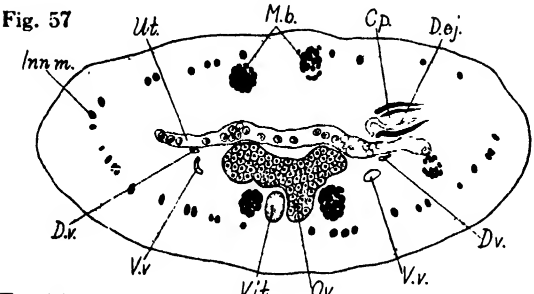

Fig. 58

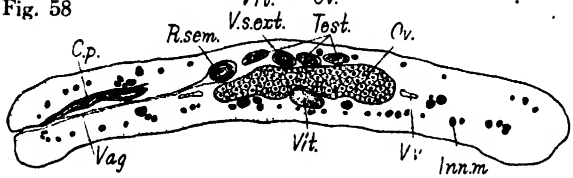

Fig. 55–58. *Hymenolepis japonica.*
Fig. 55. Mature segments 0.33 mm broad; dorsal view.
Fig. 56. Rostellar hooks 39–41 μ long.
Fig. 57. Transverse section of gravid segment through ovary.
Fig. 58. Transverse section of mature segment through testes.

The three roundish testes, 0.02–0.04 mm in diameter, lie dorsally in a transverse row, the largest antiporal one being more or less in front of the others and the one at the other end approximately in the median line. The vesicula seminalis externa lying in front of the testes is roundish or transversely elongated and measures 0.024–0.04 mm anteroposteriorly. The club-shaped cirrus pouch, 0.12–0.21 × 0.03–0.043 mm, has at its enlarged part a very muscular wall mainly composed of longitudinal fibers, and its thin-walled proximal end contains a relatively small vesicula seminalis interna. The ductus ejaculatorius is narrow and more or less convoluted The long, distally broadened cirrus is up to 0.12 mm long and 0.01 mm broad at the tip, and is covered with minute spines all over. The genital pore lies at about the middle of the right border of the proglottis.

The ovary, 0.024–0.033 × 0.15–0.2 mm, consists of three lobes, of which the small median intrudes into the space between the two ventral medial muscle bands mentioned above and the other two extend laterally between these bands and the uterus as far as the excretory stems; its breadth is very variable according to the degree of development. The small compact vitelline gland, 0.03–0.04 mm in diameter, lies ventral to the ovary, partly between the antiporal medial muscle band and the ventral lobe of the ovary. The shell gland complex lies posterodorsal to the middle of the ovary. The narrow vagina opening directly ventral to the cirrus passes medially in a loose spiral on the ventral side of the cirrus pouch. The elliptical receptaculum seminis, 0.033–0.036 × 0.045 mm, lies posteromedial to the cirrus pouch. The transversely running uterus is dorsal to the ovary and ventral to the cirrus pouch and vagina, and when fully developed fills up all the available space of the medulla,

pushing both excretory stems to the ventral side. The outer egg shell measures $30\text{–}48 \times 27\text{–}42\,\mu$ and the onchosphere $24\text{–}27\,\mu$ in diameter. The embryonic hooks vary in length from $12\,\mu$ to $18\,\mu$.

DISCUSSION. This species resembles *H. multistriata* (Rud., 1810), *H. capillaris* (Rud., 1810) and *H. capillaroides* Fuhrmann, 1906, more closely than any other species reported from podicepidiform birds, but differs from them in the size and shape of the rostellar hooks, as may be seen from a comparison of my figure with those given by Lühe for Rudolphi's species and by Fuhrmann for his.

Hymenolepis japonica n. sp.

SPECIFIC DIAGNOSIS. *Hymenolepis* Weinland, 1858; with generic characters. Body over 70×0.77 mm. Scolex 0.2–0.24 mm broad. Rostellum $0.075\text{–}0.1 \times 0.08\text{–}0.09$ mm, with ten hooks 39–41 μ long. Rostellar sac $0.14\text{–}0.18 \times 0.08\text{–}0.1$ mm. Suckers 0.06–0.08 mm in diameter. Proglottides closely crowded, with salient posterior borders; with 8 powerful longitudinal muscle bands. Excretory stems about one third of proglottis breadth from lateral border, ventral to cirrus pouch and vagina. Nerve trunk ventral to cirrus pouch and vagina, at about middle of each lateral third of proglottis. Testes 0.02–0.04 mm in diameter, antiporal one more or less in front of others. Vesicula seminalis externa in front of testes, 0.024–0.04 mm anteroposteriorly. Cirrus pouch club-shaped, $0.12\text{–}0.21 \times 0.03\text{–}0.043$ mm, with strong longitudinal muscles. Vesicula seminalis interna small, at proximal end of cirrus pouch Ductus ejaculatorius somewhat convoluted. Cirrus 0.12×0.01 mm, distally enlarged, armed with minute spines all over. Genital pore dextral, approximately equatorial. Ovary roughly three-lobed, $0.024\text{–}0.033 \times 0.15\text{–}0.2$ mm, may extend laterally as far as excretory stems Vitelline gland compact, 0.03–0.04 mm in diameter. Vagina opening ventral to cirrus. Receptaculum seminis near inner end of cirrus pouch, $0.033\text{–}0.036 \times 0.045$ mm. Outer egg shell $30\text{–}48 \times 27\text{–}42\,\mu$; onchosphere 24–27 μ in diameter; embryonic hooks 12–18 μ.

Habitat. Small intestine of *Podiceps ruficollis japonicus*.

Locality and dates. Lake Biwa; Febr. 14, 1928; Febr. 29, 1932 (type date).

Type and paratypes in my collection.

20. *Hymenolepis charadrii* n. sp.

DESCRIPTION. Several specimens from the small intestine of *Charadrius alexandrinus dealbatus* (Swinhoe). They were already more or less strongly macerated, so that the following brief note based on them needs further detailed redescription. The mature type is 3.9 mm in length and 0.38 mm in maximum breadth near the posterior end. The roundish scolex is 0.13 mm broad. The ten rostellar hooks are $57\text{–}66\,\mu$ long, with a sharp blade a little shorter than the root. The rostellar sac, 0.18×0.075 mm, is attenuated posteriorly and extends slightly further backwards than the level of the suckers. The latter are about 0.08 mm in diameter. There is a short neck about 0.1 mm long. The proglottides are 4–6 times as broad as long, except the crowded anterior ones.

The three testes, 0.02–0.024 mm in diameter, form an almost transverse row. The spherical vesicula seminalis externa, 0.02 mm in diameter, lies in front of the middle testis or anteromedial to the antiporal one. The spindle-shaped cirrus pouch, $0.09 \times 0.03\text{–}0.036$ mm, has a very muscular wall, which is about 0.01 mm in maximum thickness at the middle. There is an elongate spindle-

Fig. 60

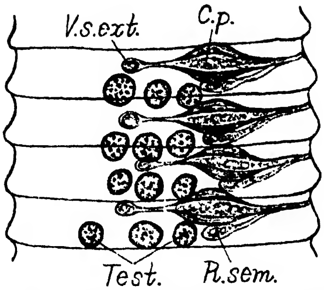

Fig. 59

Fig. 59–60. *Hymenolepis charadrii.*
Fig. 59. Rostellar hooks 57–66 μ long.
Fig. 60. Protandrously mature segments 0.31 mm broad; dorsal view.

shaped vesicula seminalis interna, which is especially well developed in anterior segments. The tubular genital cloaca opens in front of the middle of the right margin of the proglottis.

The transversely elongate ovary may extend outwards beyond the excretory stems. The vagina opens into the genital cloaca directly ventral to the cirrus. The elongate or occasionally roundish receptaculum seminis lies usually posteroventral to the cirrus pouch. The uterus is a transversely elongate, simple sac occupying almost the entire proglottis. The eggs could not be observed with certainty.

DISCUSSION. So far as I have been able to determine, my species differs from any of the *Hymenolepis* species described from Charadriiformes in the size and shape of rostellar hooks. In this respect it rather resembles *H. macrocephala* Fuhrmann, 1913, but differs distinctly in other characters, particularly in the scolex, and in the host. The specific diagnosis is reserved until more perfect specimens are available.

Fig. 62

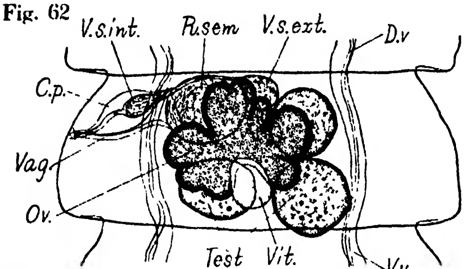

Fig. 63

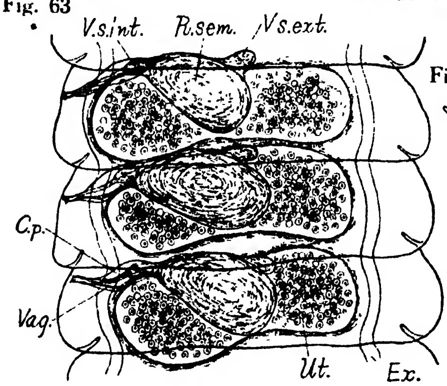

Fig. 61

Fig. 61–63. *Hymenolepis taiwanensis.*
Fig. 61. Rostellar hook 34 μ long.
Fig. 62. Mature segment 0.55 mm broad; ventral view.
Fig. 63. Gravid segment 0.71 mm broad; ventral view.

21. *Hymenolepis taiwanensis* n. sp.

DESCRIPTION. A few specimens of this cestode were found in the small intestine of *Ardea purpurea manillensis* from Formosa. The gravid type is 36 mm in length by 0.95 mm in maximum breadth near the posterior end and has about 250 segments. The scolex is 0.18–0.21 mm broad. The prominent suckers are 0.08–0.1 mm in diameter. The solid rostellum, 90 μ long by 54 μ broad, bears a crown of ten hooks which are 33–35 μ long and have a very long, basally curved root as shown in fig. 61. The elliptical rostellar sac, 0.15–0.16 × 0.06–0.084 mm, extends a

little farther backward than the posterior borders of the suckers. The neck is 0.25–0.38 mm long by 0.1–0.12 mm broad. The proglottides are broader than long throughout, with conspicuously serrate lateral borders; mature ones are 0.2–0.4 × 0.55–0.91 mm, fully gravid ones 0.3–0.6 × 0.8–0.95 mm, the last few being more or less attenuated.

The inner longitudinal musculature is fairly well developed. The dorsal and ventral excretory stems lie in the same sagittal plane on the ventral side of the cirrus pouch and vagina, both curving inwards at the posterior end of each segment.

Two of the three roundish testes, 0.1–0.11 mm in diameter, lie tandem or slightly oblique on the antiporal side, and the other one usually level with the posterior one of the two or occasionally a little farther in front. The vesicula seminalis externa lies in the median line anterodorsal to the ovary, and is connected with the internal vesicle by means of a short wide twisted duct. The club-shaped cirrus pouch, 0.13–0.14 × 0.04–0.056 mm, extends slightly mediad to the excretory stems, and contains at the base a distinct vesicula seminalis interna which may occasionally be reduced to a simple duct. The almost straight cirrus opens with the vagina just behind the middle of the right margin of the proglottis.

The coarsely lobed ovary, 0.15–0.18 × 0.2–0.24 mm, lies ventrally in the center of the proglottis. The compact vitelline gland, 0.06–0.07 × 0.06–0.1 mm, is directly behind the ovary. The exceedingly large ovoid receptaculum seminis, 0.13–0.22 × 0.13–0.18 mm, lies dorsal to the ovary on the pore side of the median line near the anterior border of the proglottis, becoming a somewhat elongated sac in the last gravid segments. The uterus occupies the entire medullary parenchyma. The outer egg shell is 66–87 × 48–69 μ and the embryonic shell surrounded by a yolk membrane 36–45 × 33–42 μ. The onchospheres are 33–36 × 27–33 μ and their hooks 20 μ long.

Discussion. This worm resembles *Weinlandia corvi* Mayhew, 1925, more closely than any of the known species* from Ardeiformes, but differs from it in the host and probably in the eggs, though mature eggs of Mayhew's species are not known.

Hymenolepis taiwanensis n. sp.

Specific Diagnosis. *Hymenolepis* Weinland, 1858; with generic characters. Body 36 × 0.95 mm. Scolex 0.18–0.21 mm broad. Suckers 0.08–0.1 mm in diameter. Rostellum solid, about 90 × 54 μ. Rostellar sac 0.15–0.16 × 0.06–0.084 mm. Rostellar hooks 10, 33–35 μ long. Neck 0.25–0.38 × 0.1–0.12 mm. Testes 0.1–0.11 mm in diameter, two tandem or slightly oblique on antiporal side and the third level with the posterior one of the two. Cirrus pouch club-shaped, 0.13–0.14 × 0.04–0.056 mm, extending slightly mediad to excretory stems. Genital pore just postequatorial. Ovary coarsely lobed, 0.15–0.18 × 0.2–0.24 mm. Receptaculum seminis 0.13–0.22 × 0.13–0.18 mm. Embryonic shell 36–45 × 33–12 μ. Onchospheres 33–36 × 27–33 μ.

Habitat. Small intestine of *Ardea pupurea manillensis*.

Locality and date. Formosa; Jan. 5, 1934.

Type and paratypes in my collection.

*Listed in Fuhrmann's "Les ténias des oiseaux", 1932, p. 151.

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22. *Haploparaxis japonensis* n. sp.

DESCRIPTION. A number of this worm were found in the large intestine and ceca of *Anas platyrhyncha platyrhyncha* from Ôita and Siga Prefectures. They were fixed in Schaudinn's solution with acetic acid added under slight cover glass pressure and stained with iron-hematoxylin. The type, 45 × 1.2 mm, has more than 500 segments, all definitely broader than long. The scolex is 0.33 mm broad at the level of the suckers which are 0.125 mm in diameter. The obtuse rostellum, 0.21 × 0.16 mm, bears stout marginal hooks 57–60 μ long. The exact number of the hooks could not be determined, because they were completely lost in all paratypes and only one was left on the type. The rostellar sac is 0.5 mm long by 0.15 mm broad and extends a little farther

Fig. 66

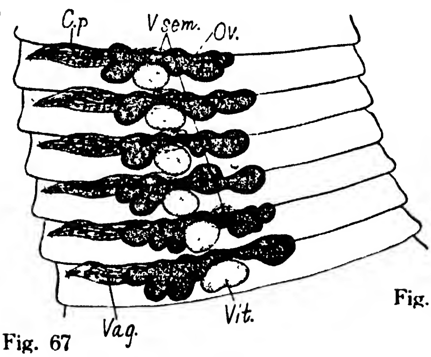

Fig. 65

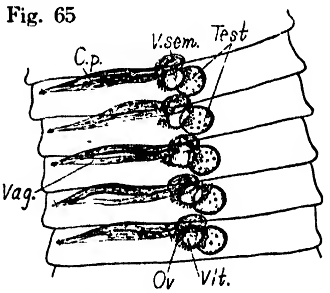

Fig. 68

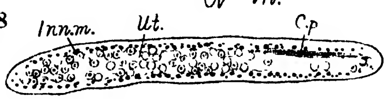

Fig. 67

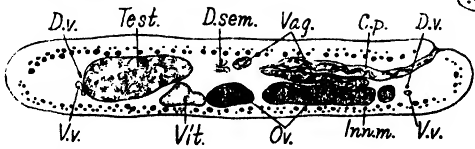

Fig. 64

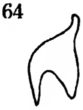

Fig. 64–68. ***Haploparaxis japonensis.***
Fig. 64. Rostellar hook 58 μ long.
Fig. 65. Immature segments 0.63 mm broad; ventral view.
Fig. 66. Mature segments 0.8 mm broad; ventral view.
Fig. 67. Transverse section of mature segment at level of genital pore.
Fig. 68. Transverse section of gravid segment.

backwards than the acetabular level. The neck is slender and only 0.075 mm broad. The mature proglottides with salient posterior borders are 0.1–0.11 × 0.63–0.8 mm and the gravid ones 0.11 × 1.2 mm. The inner longitudinal muscle sheath is composed of much smaller outer bundles and larger inner ones. The narrow, thick-walled dorsal and wide, thin-walled ventral excretory vessels lie on each side just at the middle of the lateral third of the proglottis, ventral to the cirrus pouch and vagina.

The single, ovoid testis, 0.06 × 0.08 mm, lies a little to the antiporal side of the median line, and tends to atrophy as the ovary develops, so that it cannot be recognized in fully mature segments. The voluminous vesicula seminalis externa turns back on itself on the dorsal side of the ovary. The elongate cirrus pouch, measuring 0.21–0.22 × 0.036–0.04 mm and with wall consisting of strong longitudinal muscle fibers, extends medially to the dorsal side of the pore side lobe of the ovary and contains a wide ductus ejaculatorius. The narrow cirrus projects on the top of a papilla into the genital sinus which opens on the dorsal surface of the proglottis near its left margin at about the equator.

The coarsely lobed ovary, 0.27–0.3 mm broad, and the slightly indented vitelline gland, 0.05–0.06 × 0.08–0.1 mm, are situated ventrally in the median field. The vagina opening directly dorsal to the cirrus is conspicuous by its width and distended with spermatozoa; it extends medially between the cirrus pouch and the ovary as far as the median line, where it narrows into the somewhat convoluted ductus seminalis; in gravid segments the contained spermatozoa are pushed aside by the uterus, and a conspicuous globular receptaculum seminis vaginae appears on the pore side of the uterus. The transversely elongated uterus, when filled with eggs, occupies the entire medullary parenchyma, leaving on the ventral side a narrow space for the cirrus pouch, vesicula seminalis externa and vagina. The eggs have a delicate outer envelope, 45 × 36 μ, and a subglobular inner shell, 30–36 × 27–30 μ, but no polar plugs as in *H. sinensis* Shen Tseng, 1933. The onchospheres are 21–25 × 18–21 μ and their hooks about 14 μ long.

Discussion. This species bears a closer resemblance to *H. sinensis* Shen Tseng, 1933, than to any other known members of the genus, but differs from it distinctly in the size of rostellar hooks, in the character of eggs, etc. Shen Tseng's statement that the vagina and the excretory vessels lie dorsal to the cirrus pouch is obviously erroneous; they are ventral to the cirrus pouch.

Haploparaxis japonensis n. sp.

Specific Diagnosis. *Haploparaxis* Clerc, 1903; with generic characters. Length 45 mm or more, maximum breadth 1.2 mm, with over 500 segments. Scolex 0.33–0.37 mm broad; rostellum 0.13–0.21 × 0.16–0.18 mm, obtuse in front; rostellar hook 57–60 μ long; rostellar sac extending only slightly farther backwards than acetabulum. Suckers 0.12–0.15 mm in diameter. Neck attenuated, 0.07–0.15 mm broad. Proglottides definitely broader than long throughout, with salient posterior borders. Excretory stems at middle of each lateral third of proglottis. Testis ovoid, about 0.06 × 0.08 mm. Vesicula seminalis externa voluminous, reflexed. Cirrus pouch muscular, 0.21–0.22 × 0.036–0.04 mm. Genital pore dorsolateral, approximately equatorial. Ovary coarsely lobed, 0.27–0.3 mm broad. Vitelline gland 0.05–0.06 × 0.08–0.1 mm. Vagina distended with spermatozoa, form-

ing globular seminal receptacle on pore side of gravid uterus. Uterus occupying entire medulla. Outer egg shell 45×36 μ, without polar plugs; inner shell 30–36×27–30 μ; onchospheres 21–25×18–21 μ, with hooks about 14 μ long.

Habitat. Large intestine and ceca of *Anas platyrhyncha platyrhyncha*.

Localities. Ôita Prefecture (type locality); Siga Prefecture.

Dates. Jan. 27, 1932 (type date); Dec. 29, 1931.

Type and paratypes in my collection.

23. *Haploparaxis dujardini* (Krabbe, 1869)

On the basis of a comparison of my material from *Turdus eunomus* Temm. with Fuhrmann's detailed description I shall make here some additional and emendatory notes.

The specimens in my hands measure up to 11 mm long by 0.8 mm broad. The rostellar hooks, 16–18 μ long, are arranged in a single circle around the bulbous rostellum 0.075–0.09 mm broad. The subglobular rostellar sac is about 0.16 mm long and 0.15 mm broad. The suckers are 0.066–0.1 mm in diameter. The scolex is distinctly constricted off from the almost uniformly broad strobila with prominent lateral edges. The single testis, 0.06 mm long by 0.11 mm broad, lies just inside the antiporal excretory stems. The vesicula seminalis externa is very variable in size, shape and position according to the degree of development; usually it turns back on itself on the dorsal side of the inner end of the cirrus pouch. The nearly cylindrical cirrus pouch is also variable in length, measuring 0.12–0.25 mm long and 0.02–0.03 mm broad; when contracted it may terminate at the pore side end of the ovary but when extended it reaches to the median line. The elongate vesicula seminalis interna occupies the greater proximal end of the cirrus pouch. The slender cirrus may be as long as 0.12 mm when fully protruded and is attenuated distally, with its proximal half beset with small spines. In Fuhrmann's figure 3 the cirrus is apparently not yet fully everted.

The ovary is stated by Fuhrmann to be a simple, cylindrical sac, but in immature proglottides it is distinctly lobed and measures 0.05–0.08 mm long by 0.17–0.22 mm broad; it lies on the pore side of the median line, with its lateral edge extending as far as the excretory stems of that side. The compact, subglobular to oval vitelline gland, 0.03–0.05 mm long by 0.06–0.08 mm broad, lies ventromedial to the testis. The narrow vagina opening into the genital sinus on the ventral side of the cirrus passes inwards on the posteroventral side of the cirrus pouch and forms a transversely elongated receptaculum seminis, which lies usually dorsal to the pore side lobe of the ovary and posteroventral to the cirrus pouch. The delicate globular to oval outer shell is 36–60×30–45 μ and the thicker, rigid middle shell 27–33×26–30 μ. As pointed out by Fuhrmann, the middle shell becomes thicker as the embryo develops, up to 3 μ thick or more. The onchospheres are 18–27×18–22 μ and the embryonic hooks are just as long as in Krabbe's original description as cited by Fuhrmann. It is certain that the egg size (0.011 mm in diameter) given by Fuhrmann is erroneous, because it is identical with Krabbe's measure-

ment of the embryonic hooks.

24. *Haploparaxis scolopacis* n. sp.

DESCRIPTION. A number of specimens from the small intestine of *Scolopax rusticola* Linn. The body is slender, up to 27 cm long and 1.1 mm broad at the posterior gravid segments. The scolex, fixed under a cover slip, is 0.27 mm broad. The rostellum, 0.11 × 0.1 mm, bears a single circle of ten hooks 30–35 μ long and with a relatively long stout guard, as shown in fig. 69. The rostellar sac, 0.36 × 0.11 mm, extends farther backwards than the suckers. The latter is 0.075 mm in diameter. There is an unsegmented neck region. The proglottides are much broader than long throughout and have conspicuously serrate borders; the gravid ones measure 0.12–0.18 × 0.6–1.1 mm. The dorsal and ventral excretory trunks lie in the anterior segments between the lateral and middle third of the proglottis, but further outwards in gravid segments, and run ventral to the cirrus pouch, vagina, ovary and uterus on the pore side, but dorsal to the ovary and uterus on the other side. The transverse anastomosis of the ventral vessels occurs at irregular intervals and not always at the posterior end of the proglottis. There are two distinct layers of inner longitudinal muscles.

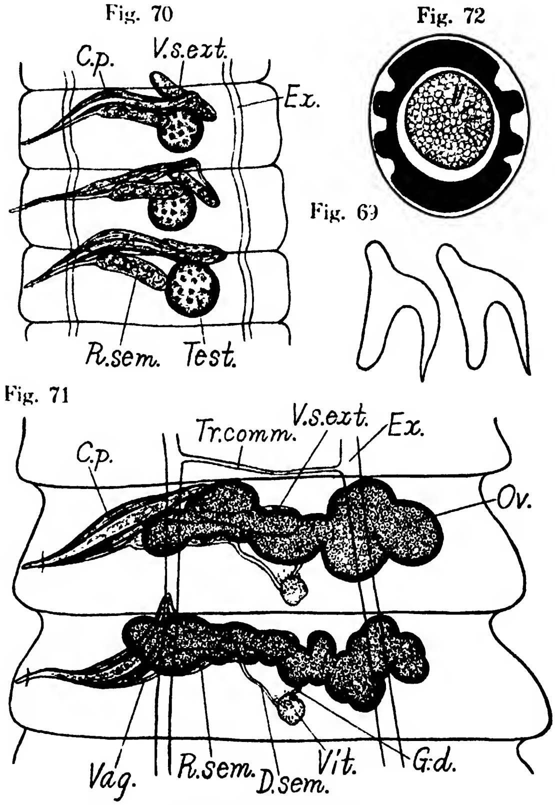

Fig. 69–72. *Haploparaxis scolopacis.*
Fig. 69. Rostellar hooks 30–33 μ long.
Fig. 70. Immature segment 0.32 mm broad; ventral view.
Fig. 71. Mature segment 0.55 mm broad; ventral view.
Fig. 72. Egg containing onchosphere 27 μ long by 25 μ broad.

The spherical testis, 0.05–0.06 mm in diameter, can be seen only in the anterior segments with undeveloped female genitalia, a little further away from the pore side than from the other. The cylindrical or club-shaped vesicula seminalis externa lies directly in front of the testis or dorsal to the ovary and uterus near the anterior end of the proglottis; it may be transverse or oblique in position, with its proximal

end directed toward the pore side or away from it. The vas deferens is irregularly curved in accordance with the position of the vesicula seminalis externa. The muscular, thick-walled cirrus pouch, 0.12–0.18 × 0.03–0.035 mm, is straight or curved with its convexity directed forward or backward, and may extend across the median line in anterior segments, though usually not reaching to it. The vesicula seminalis interna is tubular. The very slender cirrus covered by exceedingly small spines may protrude from the common genital sinus and attain a length of 36 μ. The unilateral genital pore lies behind the middle of the right border of the proglottis.

The transversely elongate, ventral ovary extends slightly further outwards than the excretory trunks. The small compact vitelline gland is situated in the median line posteroventral to the ovary. The vagina opens into the genital sinus on the ventral side of the cirrus. The elongate receptaculum seminis is straight or sinuous, and usually lies posteroventral to the cirrus pouch and dorsal to the pore side portion of the ovary. The narrow ductus seminalis passes obliquely backwards to join the germiduct behind the ovary. The gravid uterus occupies almost the entire proglottis, leaving a narrow lateral strand free. The membranous outer egg shell is 54–60 μ in diameter and the middle 45–51 × 39–45 μ. It is very interesting to note that this middle shell increases in thickness as development proceeds and has three shallow circular grooves at about its middle. The onchospheres are 27–30 μ in diameter, with three pairs of hooks 15–17 μ long.

DISCUSSION. This cestode bears a certain resemblance to *H. crassirostris* (Krabbe, 1869), *H. sinensis* Shen Tseng, 1932, and *H. pseudofilum* (Clerc, 1902), but differs from them in the characters of eggs or in the length of rostellar hooks. *H. parafilum* Gasowska, 1931, could not be drawn into comparison, since the original paper is inaccessible to me.

Haploparaxis scolopacis n. sp.

SPECIFIC DIAGNOSIS. *Haploparaxis* Clerc, 1903; with generic characters. Body 27 cm long by 1.1 mm broad. Scolex 0.27 mm broad when flattened. Rostellar hooks 10, 30–35 μ long. Rostellar sac extending farther backwards than suckers. Suckers about 0.075 mm in diameter. Neck present. Proglottides much broader than long, with serrate margins. Dorsal and ventral excretory stems ventral to cirrus pouch, vagina, ovary and uterus on pore side, but dorsal to ovary and uterus on the other side. Transverse anastomosis of ventral vessels at irregular intervals. Testis 0.05–0.06 mm in diameter, slightly to antiporal side. Vesicula seminalis externa variable in position. Cirrus pouch straight or falcate, 0.12–0.18 × 0.03–0.035 mm, may extend across median line in anterior segments but only one third of proglottis breadth in fully gravid ones. Cirrus 36 × 3 μ, covered by exceedingly small spines. Genital pores dextral, postequatorial. Ovary extending beyond ventral excretory stems. Receptaculum seminis elongate, frequently sinuous. Outer egg shell membranous, 54–60 μ in diameter; middle shell thick, 45–51 × 39–45 μ, with three shallow circular grooves at about its middle. Onchospheres 27–30 μ in diameter; embryonic hooks 15–17 μ long.

Habitat. Small intestine of *Scolopax rusticola* Linn.

Locality and date. Mie Prefecture; Jan. 20, 1932.

Type and paratypes in my collection.

25. *Haploparaxis clerci* n. sp.

DESCRIPTION. A few specimens of this cestode were found in the small intestine of *Scolopax rusticola* Linn. from Sizuoka Prefecture. They are up to 130 mm long and 0.84 mm broad. The scolex is 0.15–0.18 mm broad. The prominent suckers are 70–80 μ in diameter. The solid rostellum, 63–96 × 36–50 μ, bears 10 hooks 18–21 μ long, and when protruded may project 0.11 mm beyond the anterior borders of the suckers. The rostellar sac, up to 60 μ broad, may extend well past the posterior borders of the suckers. The neck is 1.0–1.5 × 0.07–0.08 mm. The conspicuously imbricated proglottides with more or less recurved posterior borders are 5–6 times as broad as long, except the posterior which are only 3–4 times as broad as long. The inner longitudinal muscular bundles are well developed.

Fig. 73

Fig. 74

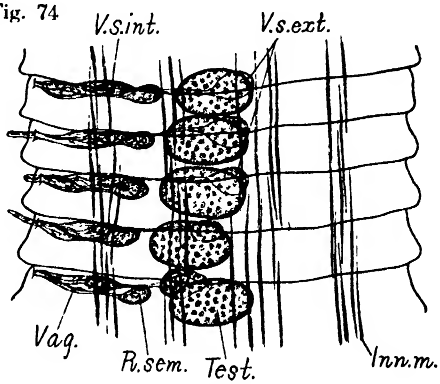

Fig. 73-74. *Haploparaxis clerci*.
Fig. 73. Rostellar hook 21 μ long.
Fig. 74. Immature segment 0.5 mm broad.

The transversely elongated oval testis, 0.05–0.06 × 0.06–0.075 mm, lies dorsally in the median plane. The pear-shaped vesicula seminalis externa measuring 28–75 μ anteroposteriorly, lies in front of or anterolateral to the testis, and may often turn back on itself on the pore side of the testis. The spindle-shaped, muscular cirrus pouch is 0.11–0.16 mm long by 0.027–0.036 mm broad and contains an elongate seminal vesicle. The protrusible cirrus covered by very small spines opens with the vagina into the genital cloaca, which in turn opens just behind the middle of the right margin of the proglottis.

The transversely elongated ovary extends to the excretory stems or a little farther outwards when fully developed. The small compact vitelline gland lies ventral to the testis. The receptaculum seminis is definitely smaller than the vesicula seminalis externa, and lies ventral to the proximal end of the cirrus pouch. The vagina passing transversely on the ventral side of the cirrus pouch may be somewhat enlarged distally. The uterus occupies the entire medullary parenchyma. The mature eggs have a thick inner shell considerably thickened at the two poles and measuring 42–51 × 33–39 μ. The onchospheres are about 21 μ in diameter and their hooks 16 μ long.

Fig. 75

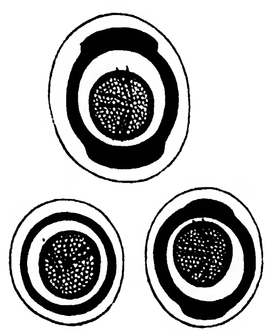

Fig. 75. Eggs of *Haploparaxis clerci* at three different stages of development.

The excretory system could not be observed in detail, since no sections were prepared.

DISCUSSION. This species differs from *H. scolopacis* mihi in the characters of eggs and in the size of rostellar hooks. In this respect it differs also from *H. sinensis* Shen Tseng, 1932, though the two species are closely related in other characters. A comparison with *H. pseudofilum* (Clerc, 1902) is not possible because of lack of detailed information, so that my species should be looked upon as provisional.

Haploparaxis clerci n. sp.

SPECIFIC DIAGNOSIS. *Haploparaxis* Clerc, 1903. Body 130×0.84 mm or larger. Scolex 0.15–0.18 mm broad. Rostellum 63–96×36–50 μ; rostellar hooks 18–21 μ long. Suckers 70–80 μ in diameter. Neck 1.0–1.5×0.07–0.08 mm. Proglottides 3–6 times as broad as long. Testis 0.05–0.06×0.06–0.075 mm, median. Vesicula seminalis externa variable in position. Cirrus covered by very small spines. Genital pore just postequatorial. Ovary extending laterally beyond excretory stems when fully developed. Receptaculum seminis smaller than vesicula seminalis externa. Inner egg shell thick, 42–51×33–39 μ, with polar thickenings. Onchospheres about 21 μ in diameter; hooks 16 μ long.

Habitat. Small intestine of *Scolopax rusticola* Linn.

Locality and date. Sizuoka Prefecture; Dec. 23, 1933.

Type and paratypes in my collection.

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Shen Tseng, Studies on avian cestodes from China. Part II. Cestodes from charadriiform birds. Parasit., Vol. 24, 1932, p. 500–501.

26. *Diorchis nyrocae* n. sp.

DESCRIPTION. A single immature specimen of this species was found on December 5, 1931, in the cecum of *Nyroca* (*Fuligula*) *marila mariloides* from Lake Biwa. It was fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam. The body is 14.2 mm long. The scolex is 0.15 mm broad. The rostellum is about 0.06 mm long and 0.04 mm broad at its enlarged tip. There is a single crown of ten hooks, which are 27 μ long and have the shape shown in fig. 77. The longitudinally elongated suckers are 0.1 mm long and bear along their borders exceedingly small spines arranged close together like a file. The unsegmented neck is 0.4 mm long by 0.075 mm broad. The crowded proglottides with prominent posterior borders are about ten times as broad as long, the posteriormost ones measuring 0.031×0.32 mm. The longitudinal muscle sheath as well as the eight inner muscle bands characteristic of the genus is well developed. The wide, thin-walled ventral excretory stems lie each about one third the breadth of the proglottis from the lateral margin. On the pore side the narrow, thick-walled dorsal stem lies dorsolateral to the ventral one, while on the other side it lies slightly dorsomedial to the latter; both are ventral to the cirrus pouch and vagina.

The testes are situated one on either side of the median line, the one on the pore side measuring 0.015 × 0.036 mm and the other 0.024 × 0.036 mm in posterior segments; the former shows a marked tendency to be flattened anteroposteriorly. The voluminous, median vesicula seminalis externa lying directly in front of the testes may extend to the lateral edge of the antiporal testis. The elongate, slightly undulating cirrus pouch, 0.12–0.14 × 0.012–0.015 mm, may reach to the median line but not beyond it, and is almost entirely occupied by the vesicula seminalis interna. The cirrus is only slightly enlarged at about the middle and armed sparsely with very small, inconspicuous spines at the base; it is 26 μ long and 5 μ broad when fully protruded. The genital pore lies at about the middle of the right margin of the proglottis or a little farther in front.

Fig. 76

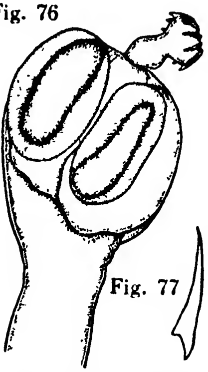

Fig. 77

Fig. 78

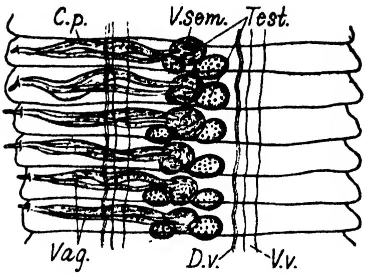

Fig. 76-78. *Diorchis nyrocae.*
Fig. 76. Scolex 0.15 mm broad.
Fig. 77. Rostellar hook 27 μ long.
Fig. 78. Immature segment 0.32 mm broad; ventral view.

The female reproductive organs are not yet fully developed in my specimens. The vagina opening into the genital sinus directly ventral to the cirrus passes medially to form a large, transversely elongate receptaculum seminis on the posteroventral side of the proximal end of the cirrus pouch.

DISCUSSION. This species bears certain resemblances to *D. acuminata* (Clerc, 1902), *D. excentricus* Mayhew, 1925, and *D. microcirrosa* Mayhew, 1929, but differs from all of them chiefly in the characters of the cirrus. *D. spiralis* Szpotanska, 1931, is known to me only by name.

The armature of the suckers as observed in my species is not unusual, since it was found by Ransom in *D. acuminata* (Clerc) and *D. americana* Ransom and by Johnston in *D. flavescens* (Krefft).

The specific diagnosis is reserved until mature worms are available.

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Ransom, B. H. The taenioid cestodes of North American birds. Bull. U. S. Nat. Mus., 1909, p. 42–51.

27. *Diploposthe laevis* (Bloch, 1782) Jacobi, 1896

This species was found on December 13, 1931, in the small intestine of *Nyroca* (*Nyroca*) *ferina ferina* (Linn.) from Lake Biwa. On its anatomical details Jacobi's paper may be referred to. In the following only the measure-

ments in mm on mounted specimens will be given for later reference.

Strobila up to 210 × 5.6; scolex 0.2 broad; rostellar sac 0.14 × 0.048; rostellar hooks 0.019 long; suckers 0.054 in diameter; proglottides 0.37–1.0 × 3.7–5.6; testes 0.12–0.18 × 0.17–0.2; vesicula seminalis externa 0.125 broad; cirrus pouch 0.17–0.4 × 0.13–0.18; cirrus 0.16 × 0.06 when protruded; cirrus hook 0.004 long; ovary 0.18–0.3 × 0.5–0.63; vitelline gland 0.1–0.17 × 0.12–0.22; onchospheres 0.031–0.036 × 0.027–0.03; hooks about 0.015 long.

Fig. 80

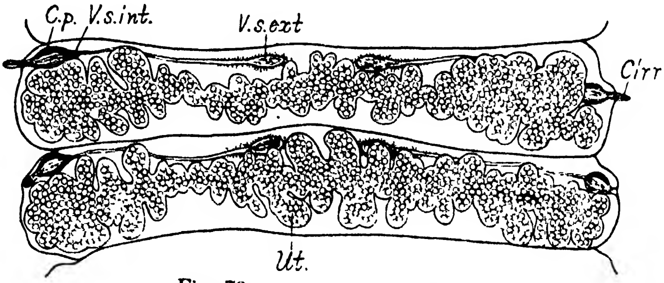

Fig. 79

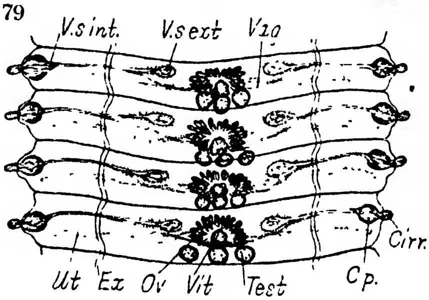

Fig. 79–80. *Diploposthe laevis* (Bloch, 1782)
Fig. 79. Mature segments 3.7 mm broad.
Fig. 80. Gravid segments 5.5 mm broad; ventral view.

In my specimens the narrow thick-walled excretory stem lies medial to the wide thin-walled one, both at about the middle of each lateral half of the proglottis, though they are shown by Jacobi more laterally in his plate-figure 3.

LITERATURE CITED

Jacobi, A. *Diploposthe laevis*, eine merkwürdige Vogeltänie. Zool. Jahrb., Anat., Bd. 10, 1897, p. 287–306.

28. *Fimbriaria fasciolaris* (Pallas, 1781)

Iwata and Tamura found this species rather rarely in the Japanese domestic duck. I have found it in the small intestine of *Anas platyrhyncha platyrhyncha* and *Mergus merganser merganser* from Lake Biwa. On the anatomy of the worm I have nothing to add to Wolffhügel's detailed description.

LITERATURE CITED

Iwata, S. and Tamura, O. Some intestinal parasites in the duck from Japan. Annot. Zool. Japon., Vol. 14, No. 1, 1933, p. 3.
Wolffhügel, K. Beitrag zur Kenntnis der Vogelhelminthen. Inaug. Diss., 1900.

TAENIIDAE Ludwig, 1886

29. *Cladotaenia circi* n. sp.

DESCRIPTION. Several specimens from the small intestine of *Circus aeruginosus aeruginosus* (Linn.). The type, the largest of all, is 133 mm long by 1.83 mm broad, and has 281 segments. The scolex is 0.2 mm broad. The disc-shaped rostellum, 0.042 × 0.072 mm, bears 48 hollow hooks in two alternate rows, those of the anterior row being 24 μ long and those of the posterior 18 μ long. The suckers are 0.08 mm in diameter. The slender neck is 0.94 mm long by 0.11 mm broad. The proglottides with prominent posterior borders are broader than long, but some gravid ones may be longer than broad. The end proglottides are approximately moniliform and measure 1.7–1.8 × 2.5–2.6 mm. The subcuticular and the inner longitudinal muscles are well developed. The transverse musculature except the outermost layer runs in isolated fibers and occupies almost the whole medullary parenchyma. The wide ventral

Fig. 81 Fig. 82 Fig. 83

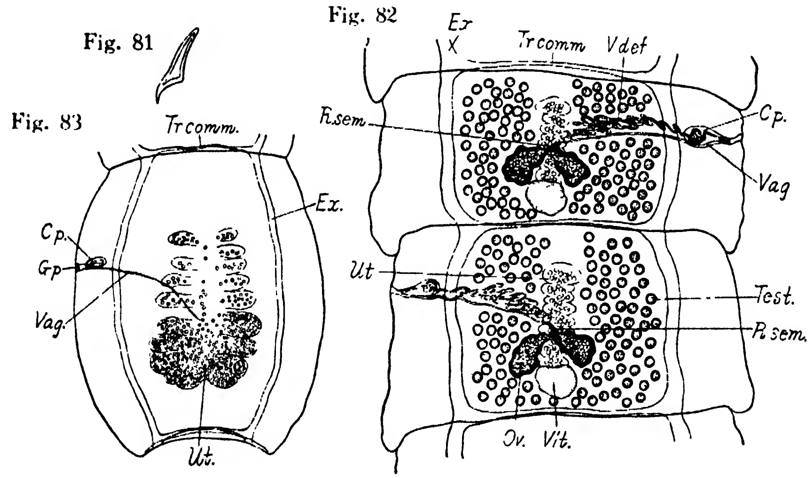

Fig. 81–83. *Cladotaenia circi*.
Fig. 81. Rostellar hook 22 μ long.
Fig. 82. Mature segments 1.4 mm broad; ventral view.
Fig. 83. Gravid segment 1.68 mm broad; ventral view.

excretory stems lie about one sixth to one fourth of the proglottis breadth from the lateral margins, and communicate with each other by a fairly wide commissure at the posterior end of each proglottis. The dorsal stems could not be detected. The lateral nerve cord passes along the ventral excretory stem.

The testes, 90–110 in number for each proglottis, are arranged in the medulla in two lateral groups which are united behind the vitelline gland. The vas deferens describes a number of transverse loops between the proximal end of the cirrus pouch and the median line, passing dorsal to the excretory stem. The relatively thin-walled, pyriform cirrus pouch, 0.12–0.15 × 0.05 mm, extends

to near the excretory stem but never beyond it. The narrow ductus ejaculatorius forms one or two coils at the enlarged base of the cirrus pouch. The cirrus, 0.06 mm long or longer and 0.03 mm broad at the base, opens into the genital atrium immediately in front of the vagina. In gravid end proglottides, the irregularly alternate genital pores are half as far from the anterior as from the posterior end of the proglottis but farther anteriorly in young and mature ones.

The compact, bipartite ovary, 0.16 × 0.34 mm, and the vitelline gland are situated in the median field of the posterior half of the proglottis. The simple, narrow vagina passes inwards just behind the cirrus pouch and the coiled vas deferens, and forms the receptaculum seminis just in front of the ovarial isthmus. The median uterus has 7–10 lateral pouches, of which the posterior ones contain more eggs than the anterior; it extends a little anteriorly to the level of the genital pore, leaving a fairly large free space in front, and occupies the central part of the proglottis; in the last segment it measures 1.0 × 0.7 mm. The onchospheres, 18–21 × 15–20 μ, have three envelopes, the inner yolk membrane, the middle embryonic shell measuring 24–29 × 18–24 μ, and the outer delicate membrane. The embryonic hooks are about 8 μ long.

DISCUSSION. This species differs from any of the known members of the genus *Cladotaenia* Cohn, 1901, as shown in the following table.

Cladotaenia	Number of rostellar hooks	Size of rostellar hooks in μ	Number of testes	Number of uterine pouches	Onchospheres in μ
cylindracea (Bloch) of Lühe, 1910	46	20-35	—	—	18-20 × 24-27
armigera Volz, 1900	42	32.4-39.6	60–70	4–7	27 × 19.8
feuta Meggitt, 1933	absent	—	85-97	—	—
fania Meggitt, 1933	20	6–7	73–94	12–13	—
circi n. sp.	48	18–24	90–110	7–10	18–21 × 15–20

Cladotaenia circi n. sp.

SPECIFIC DIAGNOSIS. *Cladotaenia* Cohn, 1901. Body 133 × 1.83 mm or larger. Scolex 0.2 mm broad. Rostellum small, approximately disc-shaped. Rostellar hooks 48, in two alternate rows, 18–24 μ long, those of anterior row being larger. Suckers 0.08 mm in diameter. Neck 0.94 × 0.11 mm. Young proglottides broader than long, but gravid ones longer than broad; end proglottides nearly moniliform. Testes 90–110, united behind vitellarium. Cirrus pouch 0.12–0.15 × 0.05 mm. Genital pores half as far from the anterior as from the posterior end of proglottis in gravid end proglottides, but farther in front in young and mature ones. Ovary 0.16 × 0.34 mm in mature segments. Uterus extending a little anteriorly to level of genital pore but leaving much free space in front, with 7–10 lateral pouches. Embryonic shell oval, 24–29 × 18–24 μ. Onchospheres 18–21 × 15–20 μ. Embryonic hooks about 8 μ long.

Habitat. Small intestine of *Circus aeruginosus aeruginosus*.

Locality and date. Formosa; April 20, 1933.

Type and paratypes in my collection.

LITERATURE CITED

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Meggitt, F. J. Cestodes obtained from animals dying in the Calcutta Zoological Gardens during 1931. Rec. Ind. Mus., Vol. 35, 1933, p. 161–163.
Volz, W. Beitrag zur Kenntnis einiger Vogelcestoden. Arch. Naturgesch., 66. Jahrg., Bd. 1, 1900, p. 161–163.

30. *Paracladotaenia accipitris* n. g. n. sp.

Description. A single gravid specimen of this worm was found in the small intestine of *Accipiter virgatus gularis* (Temm. et Schl.) from Formosa. It is 165 mm in length and 1.45 mm in maximum breadth at the last gravid segments. The scolex, 175 μ broad, has a disc-shaped unarmed rostellum 72 μ broad and 42 μ thick at the thickest center. The spherical suckers are 80–85 μ in diameter. The neck is about 1.0 mm long by 0.11 mm broad. The

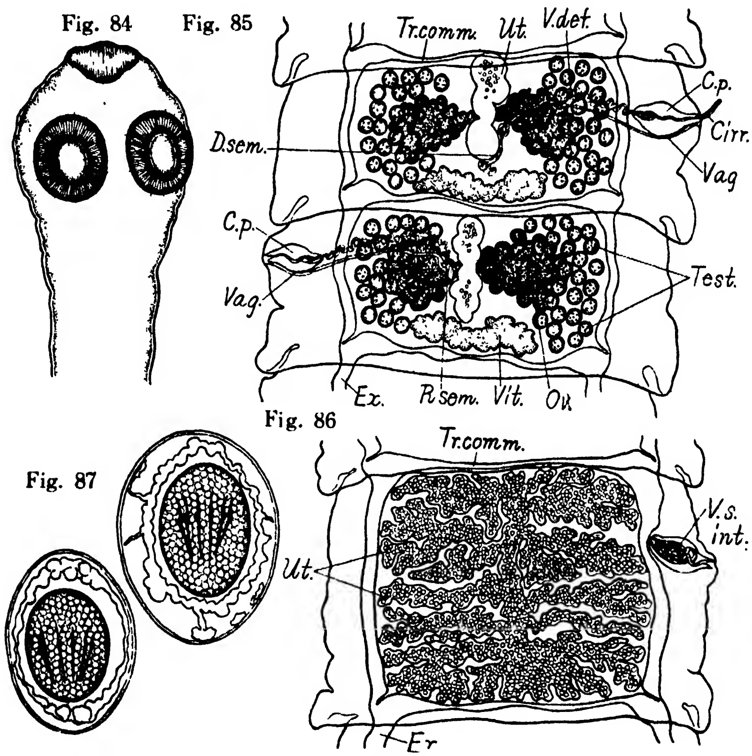

Fig. 84–87. *Paracladotaenia accipitris.*
Fig. 84. Scolex 175 μ broad.
Fig. 85. Mature segments 0.92 mm broad; dorsal view.
Fig. 86. Gravid segment 1.2 mm broad; dorsal view.
Fig. 37. Eggs 32–41 × 22–28 μ.

proglottides are conspicuously imbricated and broader than long throughout, with more or less projecting genital pores. The cuticle is very thin. The two subcuticular muscle layers are fairly well developed. The inner longitudinal

muscle sheath consists of strong isolated bundles. The transverse muscles are fine and not very conspicuous. The wide excretory stem of each side appears to receive directly the excretory tubules from the surrounding parenchyma; it lies ventral to the cirrus pouch and vagina and a little mediad of the lateral edge of the inner longitudinal muscle sheath and has a small funnel-shaped outpocketing suggestive of a rudimentary "foramen secundum" opposite the origin of the transverse commissure, where the vessel is more or less strongly inflated and has a valve in front. The transverse commissure lies at the posterior end of each segment. There is no definite dorsal excretory stem.

The roundish testes vary in number from 38 to 48, 14–23 on the pore side and 21–26 on the other; they are closely massed together in two submedian fields bordered by the excretory stems and the transverse commissures. In gravid segments, the vas deferens is strongly convoluted near the proximal end of the cirrus pouch. The elliptical or pyriform cirrus pouch, up to 0.23 × 0.1 mm, has a thin muscular wall chiefly composed of very fine circular fibers, and contains a vesicula seminalis interna at the base and a protrusible cirrus. The latter opens into the genital atrium directly in front of the vagina. The irregularly alternate genital pores lie just in front of the middle of the proglottis.

The relatively large ovary consists of two compact symmetrical lobes with an irregular outline. The transversely elongated vitelline gland is about 0.32 mm in maximum breadth and lies directly in front of the transverse excretory commissure; it is distinctly bilobed in newly gravid segments. The narrow vagina is ciliated for some distance before leading into the small, elongated seminal receptacle, which lies on the pore side of the median line near the ventral boundary of the medulla. The uterus begins as a simple median tube, but sooner or later sends out a number of digitiform lateral pouches which in turn give off smaller secondary pouches, and finally occupies the entire medullary parenchyma. The oval, rigid egg shell measures 32–41 × 22–28 μ. The onchospheres are 17–24 × 14–18 μ and the embryonic hooks about 10 μ long. There is an amorphous yolk substance between the onchosphere and the egg shell, but no radially striated embryonic shell.

DISCUSSION. In general anatomy this worm bears a certain resemblance to *Cladotaenia* Cohn, 1901, but differs from it fundamentally in the absence of rostellar hooks, in the testes being separated into two distinct groups, in the presence of a distinct vesicula seminalis interna, in the extent of the uterus, etc. According to Lühe and Fuhrmann the median stem of the uterus does not reach to the anterior end of the proglottis in *Cladotaenia*.

Paracladotaenia n. g.

GENERIC DIAGNOSIS. Taeniidae Ludwig, 1886. Rostellum unarmed. Neck present. Proglottides imbricate, broader than long throughout. Inner longitudinal muscles consisting of separate bundles. Excretory stems with valve, ventral to cirrus pouch and vagina. Genital pores irregularly alternate. Testes numerous, in two submedian fields. Conspicuous vesicula seminalis interna present. Ovary bipartite, well developed. Vitellarium distinctly bilobed in fully mature segments.

Vagina opening directly behind cirrus, with small receptaculum seminis. Uterus consisting of median stem and digitiform lateral pouches, occupying entire medulla when fully gravid. Egg shell simple, rigid, without radially striated embryonic shell. Parasitic in birds.

Genotype. *Paracladotaenia accipitris.*

Paracladotaenia accipitris n. sp.

SPECIFIC DIAGNOSIS*. *Paracladotaenia;* with generic characters. Body 165×1.45 mm. Scolex 175 μ broad. Rostellum 72 μ broad by 42 μ thick at center. Suckers 80–85 μ in diameter. Neck 1.0×0.11 mm. Testes 38–48, 14–23 on pore side, 21–26 on the other. Cirrus pouch pyriform or elliptical, 0.23×0.1 mm, with thin muscular wall. Eggs 32–41×22–28 μ. Onchospheres 17–24×14–18 μ.

Habitat. Small intestine of *Accipiter virgatus gularis* (Temm. et Schl.).

Locality and date. Formosa; December 4, 1933.

Type in my collection.

LITERATURE CITED

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Lühe, M. Cestodes. Brauer's Süsswasserfauna Deutschlands, Heft 18, 1910, p. 47.

AMABILIIDAE Fuhrmann, 1908

31. *Tatria decacantha* Fuhrmann, 1913

Large numbers of this worm were taken from the small intestine of *Podiceps ruficollis japonicus* from Lake Biwa. Although the internal anatomy could not be definitely made out, some important external features exactly correspond to those of Fuhrmann's species from *Podiceps cristatus*.

The body, up to 1.0 mm long, is covered all over with deciduous hair-like spines and has 13–15 segments with very prominent lateral edges. The ten rostellar hooks, 21 μ long, have a slightly recurved, sharply pointed blade which is about 5 μ longer than the guard. Further the rostellum is beset behind its terminal knob with exceedingly small hooks about 3.5 μ long; it is about 0.16 mm long when extended and 0.05–0.06 mm broad at the hook crown. The rostellar sac, 0.043–0.052 mm broad, does not reach to the level of the posterior borders of the suckers which are 0.07–0.09 mm in diameter.

LITERATURE CITED

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DIPHYLLOBOTHRIIDAE Lühe, 1910

32. *Digramma alternans* (Rud., 1810)

An immature specimen of this species was found in the intestine of *Podiceps*

* Subject to emendation when more specimens are found.

ruficollis japonicus from Lake Biwa. It is 18 cm in length and 5 mm in maximum breadth at the anterior third, whence it tapers gradually toward the bluntly pointed posterior end. A comparison of it with the larvae obtained from *Cyprinus carassius* and described in part 4 of this series, p. 40, shows exactly the same anatomical details in both, though differing in size. The immature state of the specimen is probably due to very recent infection.

A second similar specimen, about 40 cm long by 7.5 mm broad, was obtained from the small intestine of *Mergus merganser merganser* from the same locality.

ABBREVIATIONS USED IN FIGURES.

Atr. genital atrium
Cirr. cirrus
Cist. cistern
C. p. cirrus pouch
D. ej. ductus ejaculatorius
D. sem. ductus seminalis
D. v. dorsal excretory vessel
E. caps. egg capsule
Ex. excretory stem
F. c. fertilization canal
G. d. germiduct
G. p. genital pore
Inn. m. inner longitudinal muscle
M. b. muscle band
N. nerve cord
Ov. ovary
R. sem. receptaculum seminis
Retr. retractor muscle
Sh. gl. shell gland
Test. testis
Tr. comm. transverse excretory commissure
Tr. m. transverse muscle
Ut. uterus
Vag. vagina
V. def. vas deferens
Vit. vitelline gland
Vit. d. vitelline duct
V. s. vesicula seminalis
V. s. ext. vesicula seminalis externa
V. s. int. vesicula seminalis interna
V. v. ventral excretory vessel

Postscript on *Anthobothrium parvum* and *Lintoniella speciosa*

In accordance with Prof. Meggitt's suggestion, I propose the name *Anthobothrium exiguum* for *Anthobothrium parvum* Yamaguti, 1934, described in part 4 of this series, since the latter is preoccupied by *A. parvum* Stossich, 1895, which is regarded by Southwell as a synonym of *A. cornucopia* van Beneden, 1850.

Since *Lintoniella* n. g. which I proposed for *Rhynchobothrium speciosum* Linton, 1897, on p. 108–110 of part 4 of this series, seems to agree well with *Callotetrarhynchus* Pintner, 1931, I would withdraw my genus. Moreover, as pointed out by Doctor J. G. Baer in his letter to me, my genus is preoccupied by *Lintoniella* Woodland, 1927, so that it has in any case no ground for existence. *Rhynchobothrium speciosum* Linton, 1897, therefore becomes *Callotetrarhynchus speciosus* (Linton, 1897), as suggested by Pintner.

7. Studies on the Helminth Fauna of Japan

Part 7. Cestodes of Mammals and Snakes

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CONTENTS

INTRODUCTION

Although my material of mammalian cestodes all belong to well known species, I venture to describe them to supplement details missing in earlier descriptions or to add morphological evidences to my faunistic observations. Of reptilian cestodes only two species have been found, one in Japan proper and the other in Formosa.

I. Mammalian Cestodes

Diphyllobothriidae Lühe, 1910

1. *Diphyllobothrium stemmacephalum* Cobbold, 1858

On April 5, 1927, I found this worm in the small intestine of *Delphinus dussumieri* at Kuki. Since it was described by Cohn in detail, I will confine myself to a brief note to show its occurrence in the Pacific.

The total length of the body could not be made out, but the breadth may be as much as 20 mm.

The two surficial bothria of the scolex are coalesced at the apex but divergent at the posterior edges which are rolled in to overlap each other. On both surfaces of the strobila there are a number of longitudinal grooves, of which the median and the two submedian pairs are most conspicuous; the outer pair lies at about the middle of the lateral halves of the proglottis, in line with the medullary nerve trunks, and the inner just lateral to the uterus. The main excretory system consists of a pair of relatively thick-walled medullary stems medial to the nerve cords and a number of thin-walled vessels connected with each other by transverse commissures just outside the strongly developed inner longitudinal muscle sheath.

Fig. 1.

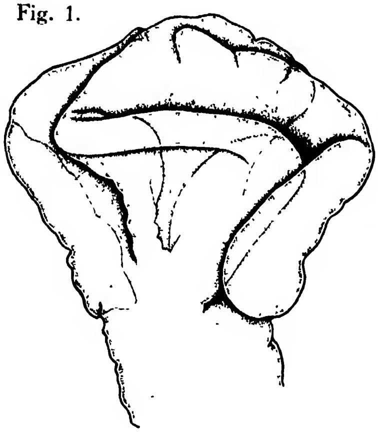

Fig. 2.

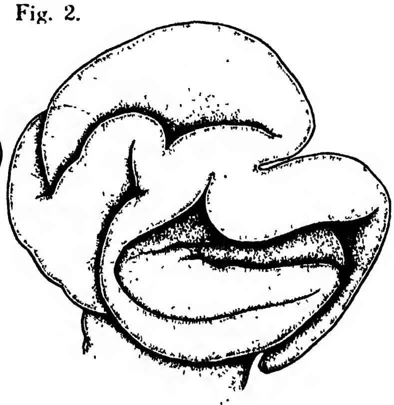

Fig. 1-2. *Diphyllobothrium stemmacephalum* Cobbold, 1858.
Fig. 1. Scolex in ventral view.
Fig. 2. Same in apical view.

The innumerable small testes lie in the medulla, mostly in one layer interrupted in the median field, but some between the inner longitudinal and transverse muscles, the innermost ones lying dorsal to the lateral edges of the ovary. Before entering the cirrus pouch the convoluted vas deferens forms a large spherical vesicula seminalis enclosed in a very muscular pouch and lined by a cylindrical epithelium. This pouch, 0.28 mm in diameter, consists of a compact inner and a loose outer muscle layers, and lies directly posterodorsal to the oval cirrus pouch. Anterodorsal to the latter there is a mass of gland cells with compact nuclei and vacuolated protoplasm stained by hematoxylin.

The bilobed ovary extends a little further outwards than the median pair of surficial grooves mentioned above. The germiduct arising from the ventral side of the ovarial isthmus proceeds posterodorsally to join the short ductus seminalis and then receives the common vitelline duct. The receptaculum seminis lies between the ovarial isthmus and the uterus. The wide distal portion of the vagina and the uterine aperture are lined by a thick cuticle. The diffuse vitellaria, interrupted in the median field, occupy the entire space between the subcuticular cell layer and the inner longitudinal muscle sheath. The tubulo-

Fig. 3

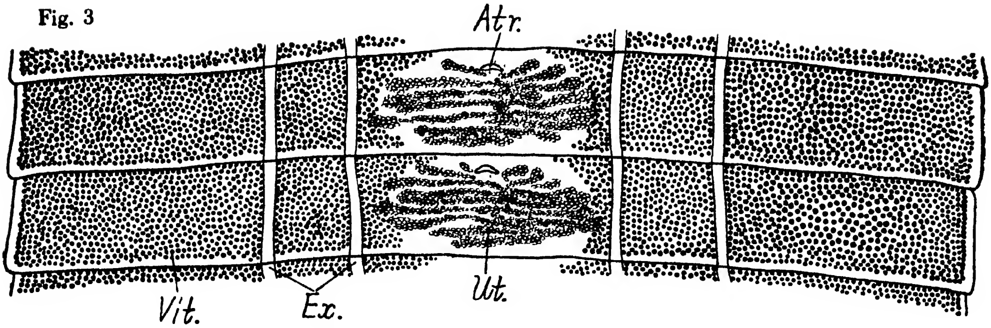

Fig. 4

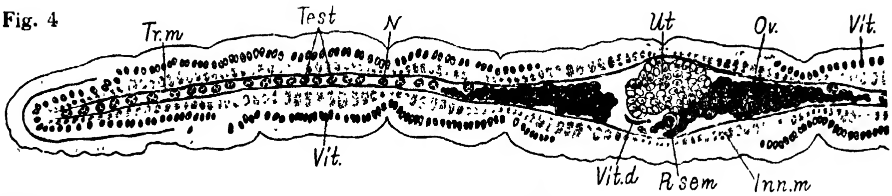

Fig. 5

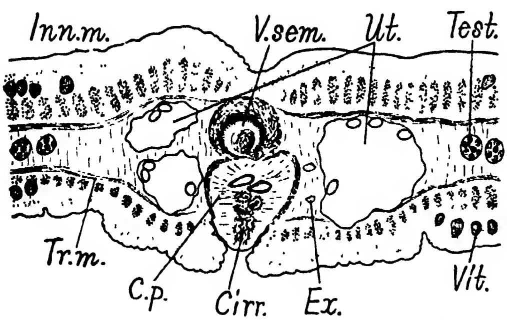

Fig. 6

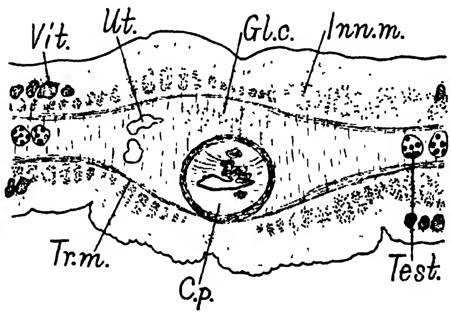

Fig. 3–6. *Diphyllobothrium stemmacephalum* Cobbold, 1858.
Fig. 3. Mature segments 13 mm broad.
Fig. 4. Transverse section of gravid segment through ovary.
Fig. 5. Same at level of genital pore.
Fig. 6. Same at level a little more in front.

saccular uterus assumes a rosette-like form when filled with eggs. The oval, brown, operculate eggs are thick-shelled and measure $63\text{–}66 \times 48\ \mu$; the contained ovum is not yet segmented.

2. *Diphyllobothrium latum* (Linn., 1758)

This species is the commonest human tapeworm in Japan. In May, 1925, when I visited Hamburg I found unexpectedly a piece of this tapeworm in my own feces, and obtained after treatment an entire worm 1.2 meter long by 6.5 mm broad. The oval, operculate, rather thin-shelled eggs, fixed in formol and measured in water, are $60\text{–}68 \times 42\text{–}50\ \mu$; the contained ova are segmented. It is very probable that I had been infected in Japan.

HYMENOLEPIDIDAE Railliet et Henry, 1909

3. *Hymenolepis diminuta* (Rud., 1819)

This species is common in Japanese *Rattus norvegicus norvegicus*, *Rattus*

Fig. 7

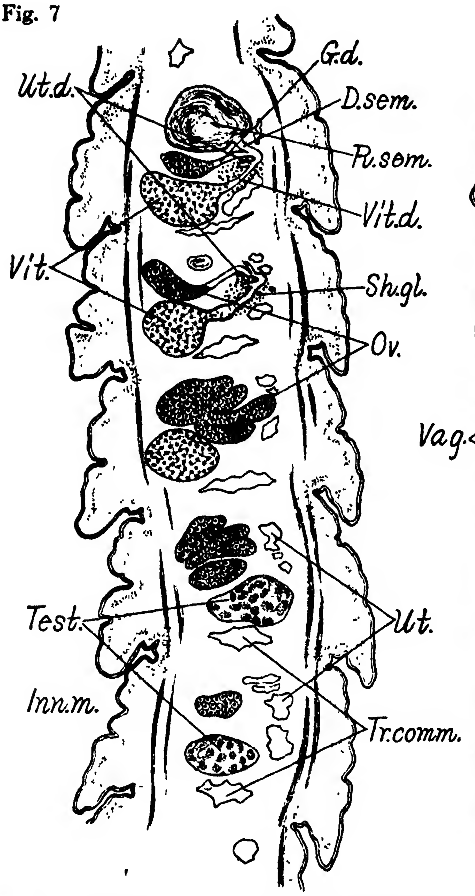

Fig. 8

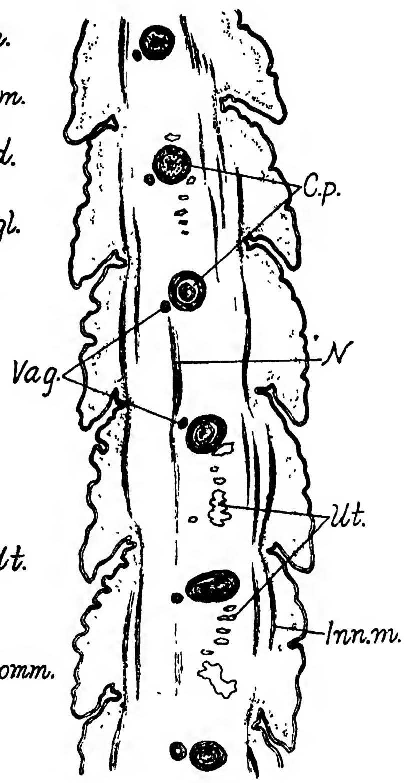

Fig. 7–8. Sagittal sections of gravid segments of *Hymenolepis diminuta* (Rud., 1819).

Fig. 9

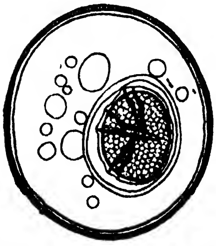

Fig. 9. Egg of *Hymenolepis diminuta.*

norvegicus var. *albus* and *Rattus rattus rattus.*

Measurements on specimens fixed in alcohol and stained with hematoxylin-eosin are as follows. Strobila up to 200 × 3.5 mm; scolex 0.2–0.21 mm broad; suckers 0.1–0.11 mm long; testes 0.05–0.1 × 0.09–0.16; cirrus pouch 0.22–0.3 × 0.04–0.05 mm; ovary 0.08–0.13 × 0.25–0.38 mm; vitelline gland 0.04–0.06 × 0.06–0.1 mm; eggs as fixed in alcohol and measured in water 54–72 × 51–68 μ; thick embryonic membrane 27–39 × 24–32 μ; onchosphere 24–30 × 21–24 μ; embryonic hooks 15 μ long.

DILEPIDIDAE Railliet et Henry, 1909

4. *Dipylidium caninum* (Linné, 1758)

To avoid unnecessary redescription I shall give only some taxonomically important data obtained from my material.

The worm is very common in Japanese dogs but rare in cats. The scolex is 0.31–0.38 mm broad. The gravid proglottides are up to 8 mm in length and 3.0 mm in maximum breadth at the middle of the posterior half. The elongate club-shaped rostellum, 0.18–0.22 × 0.088–0.096 mm, bears at its broadest part 60–86 rose-thorn-shaped hooks arranged in 4–6 alternate rows; the anterior hooks are largest and 15–18 μ long and the posterior ones are smallest and 6 μ long. The four suckers are about 0.18 mm long by 0.14 mm broad. There are 170–200 testes, more in front of the ovary than behind it. The club-shaped, strongly muscular cirrus pouch, 0.18–0.23 × 0.07–0.08 mm, usually lies outside the excretory stems but may extend farther medially; it contains a convoluted ductus ejaculatorius at the enlarged proximal end, to which is attached a strong muscular bundle directed inwards and uniting very often with its fellow of the other side. This muscle evidently functions as retractor of the cirrus pouch, because in a specimen whose genital pores are markedly depressed, the cirrus pouches of the two sides are drawn inwards across the ventral excretory stems. The genital pores lie just behind the equator of the proglottis. The strongly lobulated ovary is 0.13–0.18 × 0.25–0.28 mm. There is no receptaculum seminis vaginae. The subglobular to oval eggs as fixed in alcohol and measured in water are 36–42 × 32–36 μ, the onchospheres 20–26 μ in diameter and the embryonic hooks 12 μ long.

Although the rostellum has more rows of hooks in my specimens than in the specimens of Blanchard and López-Neyra, I venture to assign my worm to *Dipylidium caninum* Linné, 1758, because in other characters it agrees better with this species than with any other known members of the genus having the same number of hook crowns.

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TAENIIDAE Ludwig, 1886

5. *Taenia taeniaeformis* (Batsch, 1786)

Although the anatomy of this common cat tapeworm was worked out in detail by Loveland in 1894, I hope that the following brief note based on my material will not be superfluous.

The worm is up to 235 mm long and 6 mm broad. The rostellar hooks in two alternate rows vary in number from 34 to 42, those of the anterior

row being 0.4–0.43 mm long and those of the posterior 0.25–0.263 mm long. The prominent suckers are 0.3–0.33 mm in diameter. The gravid end segments are definitely longer than broad, with the maximum breadth at the middle, and their salient posterior borders are conspicuously flounced. The cuticle is 12–15 μ thick. The subcuticular cells form a thick compact layer traversed by the subcuticular longitudinal muscle fibers. The well developed inner longitudinal muscular bundles tend to form a double layer. The narrow dorsal excretory stem runs more medially than the very wide ventral one. The latter communicates with its fellow of the opposite side by a wide commissure running posterodorsal to the ovary. The nerve trunks lie on the outer side of the excretory stems, dorsal to the cirrus pouch and vagina.

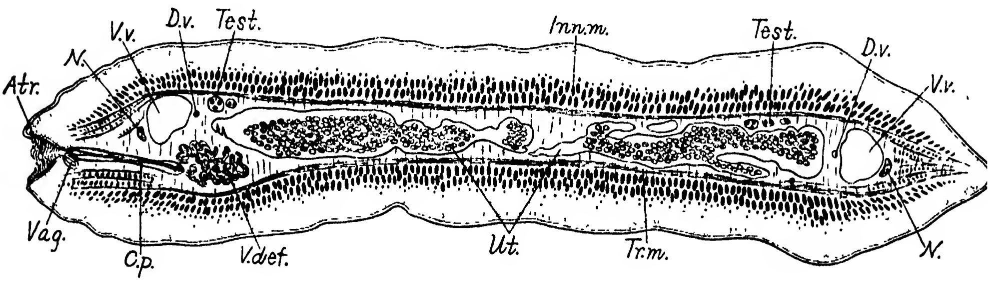

Fig. 10. Transverse section of gravid segment of *Taenia taeniaeformis* (Batsch, 1786).

The numerous testes are arranged in one or two layers in the dorsal part of the medulla between the excretory stems of the two sides. The strongly convoluted vas deferens lies ventral to the testes and uterus. The long cylindrical cirrus pouch, 0.62 × 0.063 mm and terminating on the ventral side of the excretory stems, contains a distally straight ductus ejaculatorius and a short cirrus covered by cuticular hairs. The large, more or less prominent, marginal genital atrium with strongly folded cuticular lining, opens at about the middle of the proglottis, irregularly on either side.

The bipartite ovary, about 1.0 mm broad and consisting of very fine follicular acini, lies ventrally at the posterior end of the proglottis. The vagina, beset with hairs throughout its course, has a powerful sphincter near its distal end, which opens into the genital atrium directly ventral to the cirrus. The uterus composed of a median stem and a number of digitiform side branches, occupies the entire available space of the medulla between the excretory stems. The eggs have a delicate gelatinous outer membrane and a very thick (about 3 μ thick), radially striated embryonic shell measuring 27–36 × 25–33 μ; the onchospheres are 17–21 × 15–18 μ and the hooks 11 μ long.

6. *Taenia pisiformis* (Bloch, 1780)

Although I have not yet obtained adult examples of this species, I found the larval form on April, 1927, in the liver and the abdominal cavity of hares

from Kuki, Mie Prefecture. When the scolex was pressed out of the cyst, the entire worm measured up to 13 mm in length and 6 mm in breadth. The rostellar hooks are arranged in two alternate rows of 19–22 each; the larger ones are 225–238 μ long with a simple root slightly longer than the blade, and the smaller ones 140–160 μ long with a large nodular guard. The suckers are about 0.28 mm in diameter.

7. *Multiceps serialis* (Gerv., 1847) Stiles et Stev., 1905

I found the adults of this worm in the small intestine of a hunting-dog at Kuki and the larvae in the subcutaneous and intermuscular connective tissue of a hare from the same locality. The following note is to supplement the inadequate descriptions of early workers.

ADULT. The worms are up to 130 mm long and 4.5 mm broad. The scolex is about 0.65 mm broad. The sessile rostellum, 0.23–0.26 mm in diameter, bears 26–32 hooks in two alternate rows, those of the anterior row being 138–153 μ long and those of the posterior 96–120 μ long. The four prominent suckers, 0.25 mm in diameter, are in dorsal and ventral pairs. The transversely oblong proglottides become longer toward the posterior end, where they are quadrangular or a little longer than broad; their posterior borders overlap the succeeding segment for a distance of 0.17–0.2 mm.

The inner longitudinal as well as the transverse muscles are well developed. The dorsal excretory stems are recognizable only in the anterior segments. The wide ventral excretory stem lying at about the middle of the lateral third of the proglottis, forms a bladder-like dilatation at the level of the transverse commissure. The nerve cord lies on the outer side of the ventral excretory stem, both running ventral to the terminal genital ducts.

The numerous small testes, which could not be exactly counted, are confined to the medulla between the two ventral excretory stems. In gravid segments they are recognizable on the dorsal side of or between the uterine branches. The strongly convoluted vas deferens lies almost transversely, filling up the entire thickness of the medulla. The elongate pear-shaped cirrus pouch encloses a sinuous ductus ejaculatorius at its enlarged base. The cirrus may project into the well developed genital atrium surrounded by a muscular mantle. The irregularly alternate genital pores lie at about the middle of the lateral margin of the proglottis.

The finely acinous, bipartite ovary is 0.37 mm long by 0.87 mm broad in a mature segment measuring 1.2 × 2.4 mm, but readily becomes atrophied as the uterus develops. The germiduct proceeds posterodorsally to join the recurved ductus seminalis. The uterine duct forms a few coils on the ventral side of the medulla behind the ovary. The uterus consists of a median stem reaching to the anterior end of the proglottis and a number of simple side branches extending as far as the excretory stems or a little further. The subglobular to oval, thick egg shell, 27–34 × 24–29 μ, is radially striated and surrounded by a gelatinous membrane. The onchospheres are 15–19 × 13–15 μ

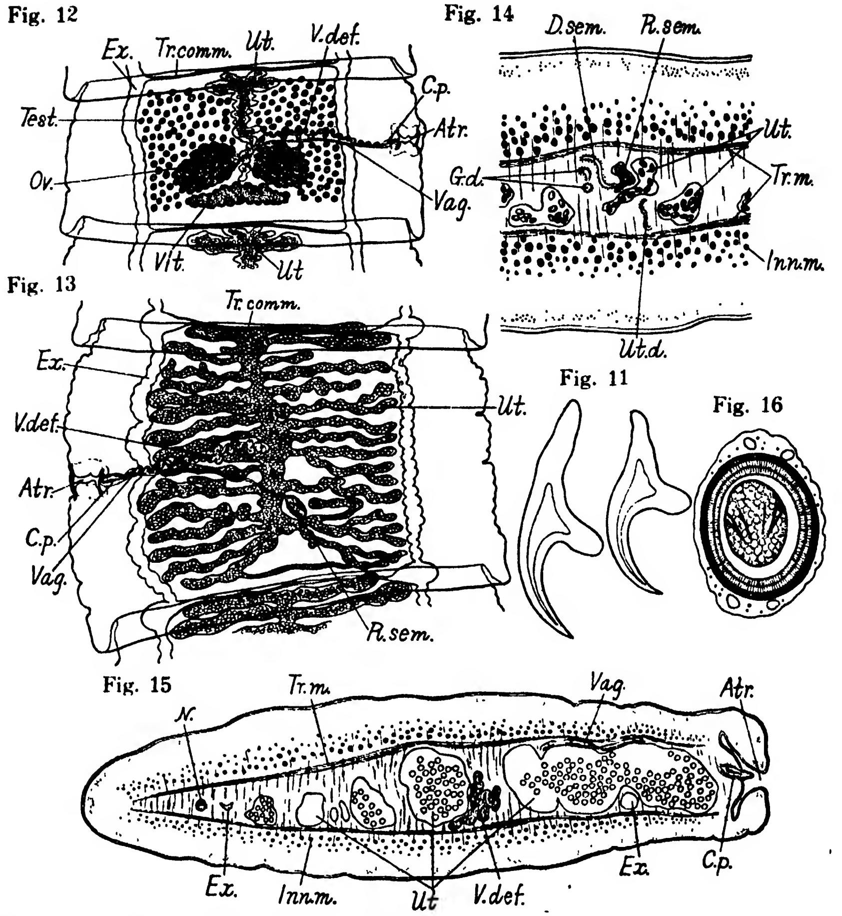

Fig. 11–16. *Multiceps serialis* (Gerv., 1847).
Fig. 11. Rostellar hooks of the two rows.
Fig. 12. Mature segment 2.4 mm broad.
Fig. 13. Gravid segment 2.94 mm broad.
Fig. 14. Transverse section of gravid segment at level of receptaculum seminis.
Fig. 15. Transverse section of gravid segment at level of genital pore.
Fig. 16. Egg.

and the hooks about 10 μ long.

The transversely elongate vitelline gland, 0.12–0.2 × 0.57–0.7 mm, lies directly behind the ovary. The vagina opening directly dorsal to and slightly behind the cirrus passes inwards on the dorsal side of the uterus; it has a hair-like covering throughout its length, and a muscular coat at the slightly wider distal portion. There is a very large receptaculum seminis dorsal to the ovary and uterus.

LARVA. The cysts are variable in size according to the degree of development, and may be as large as the hen's egg. The characteristic serial arrangement of the buds is clearly visible through the transparent cyst. The

brownish rostellar hooks in two alternate rows of 14–15 each, have a very prominent simple guard and measure in length 144–150 μ and 96–105 μ respectively.

According to Janson, Ijima fed in 1889 about 50 *Coenurus* cysts from the abdominal muscles of a hare to a dog, which yielded 52 days later 32 specimens of "*Taenia coenurus*", but there is no doubt that he had before him *Multiceps serialis* and not *Taenia coenurus.*

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8. *Catenotaenia pusilla* (Goeze, 1782) Janicki, 1904

DESCRIPTION. Two specimens of this tapeworm from the small intestine of *Mus wagneri* var. *albula* Kishida were secured from the Government Veterinary Laboratory at Nisigahara. The gravid one is 31 mm long by 1.47 mm broad and has over 60 segments, while the other mature but not gravid one is 18 mm long by 1.0 mm broad at the last (51th) segment. The scolex, 0.22–0.23 mm broad, has a closed median dorsal and ventral furrows about 0.15 mm long and uniting at the small apical prominence 36–48 μ broad. The spherical suckers, 84–90 μ in diameter, are in dorsal and ventral pairs. The neck, 0.3-0.37 mm long by 0.2 mm broad, passes imperceptibly into the scolex in the gravid example, but is distinctly constricted off in the other. The proglottides with salient posterior borders are definitely broader than long in the anterior part of the strobila, but longer than broad when mature and strongly convex at the level of the genital pore when gravid. The largest segment is 1.75 mm long and 1.0 mm broad.

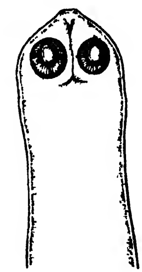

Fig. 17. Scolex of *Catenotaenia pusilla* (Goeze, 1782); 0.23 mm broad.

The cuticle is 6–9 μ thick. The subcuticular muscle sheath consists of an outer layer of circular and an inner of longitudinal fibers. The subcuticular cells form a very compact layer about 25 μ thick. The inner longitudinal muscle sheath consists of relatively fine bundles of almost equal diameter. There is no definite transverse musculature. The ventral excretory stems run on the ventral side of the cirrus pouch and vagina, and are connected with each other at the posterior end of each proglottis.

The numerous small testes are closely arranged in the posterior half of the segment between the excretory stems, but their exact number could not be ascertained. The twisted vas deferens does not form a conspicuous mass of coils. The club-shaped or elliptical cirrus pouch, 0.15–0.2 mm long, contains a twisted ductus ejaculatorius and a protrusible smooth cirrus opening into the genital atrium directly in front of the vagina. The genital pore lies in the anterior part of the middle third of the proglottis, irregularly on right or left.

Fig. 18

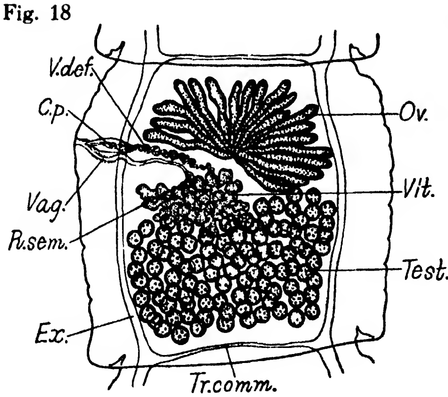

Fig. 19

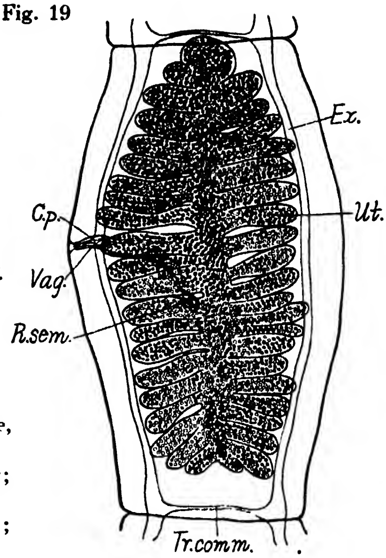

Fig. 18–19. *Catenotaenia pusilla* (Goeze, 1782).
Fig. 18. Mature segment 0.7 mm long; ventral view.
Fig. 19. Gravid segment 1.75 mm long; ventral view.

The fan-shaped median ovary consists of closely massed tubular lobules which are slightly less numerous on the pore side than on the other; it is 0.3–0.4 × 0.5–0.56 mm and occupies the greater part of the pre-equatorial medulla, leaving a moderately wide free space in front. The finely acinous vitellarium, 0.15–0.2 × 0.25–0.3 mm, lies on the pore side behind the ovary. The vagina is dilated a little at the distal end for a distance of about 0.12–0.15 mm and has a thick muscular coat. There is a roundish receptaculum seminis about 0.05–0.08 mm in diameter immediately in front of the vitellarium. The median uterine stem nearly as long as the proglottis gives off about 20 or more pouches on each side. The eggs have three thin shells, of which the outermost measures 60 × 54 μ. The onchospheres are 25 × 23 μ and the hooks 12 μ long.

II. Reptilian Cestodes

Proteocephalidae La Rue, 1911

1. *Ophiotaenia japonensis* n. sp.

Description. This species is fairly common in Japanese *Elaphe quadrivirgata* and *Natrix tigrina*. It is up to 40 cm in length and 2.3 mm in breadth. The scolex is 0.33–0.5 mm broad and continuous with the neck. There is a vestigial fifth sucker about 36 μ in diameter. The suckers are prominent, 0.15–0.28 mm in diameter and form a dorsal and a ventral pair, with their openings directed forwards. The neck is 6–13 mm long and 0.31–0.37 mm broad. The proglottides are distinct though only slightly indented at their junction; they are definitely longer than broad when gravid. The dorsal and ventral excretory vessels lie about one fifth to one sixth the proglottis breadth from

the lateral margins, and are separated from each other by the cirrus pouch and vagina. The nerve cords lie at the extreme lateral edges of the medullary parenchyma.

The testes, 90–130 in number, are arranged in two lateral fields, leaving a free median field; some of them may extend beyond the excretory stems. The compact coils of the vas deferens extends transversely between the median line and the cirrus pouch. The latter is thin-walled, cylindrical and 0.4–0.45 × 0.1–0.11 mm in mature segments but ovoid and 0.27–0.33 × 0.16–0.2 mm in

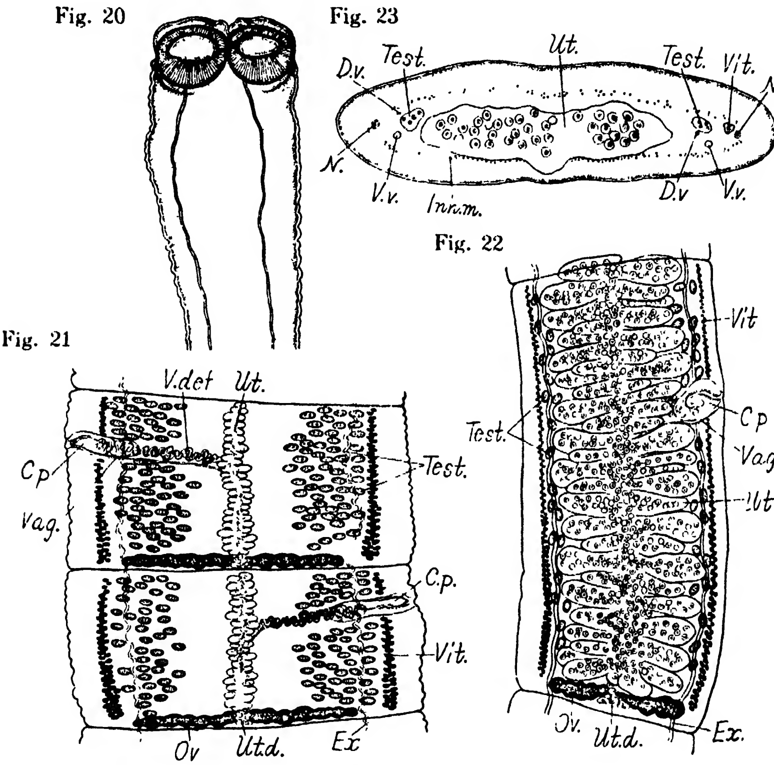

Fig. 20–23. *Ophiotaenia japonensis.*
Fig. 20. Scolex 0.5 mm broad; surficial view.
Fig. 21. Mature segments 1.83 mm broad; ventral view.
Fig. 22. Gravid segment 2.5 × 1.15 mm; ventral view.
Fig. 23. Transverse section of gravid segment near its anterior end.

gravid ones. The protrusible cirrus, lined by a thick cuticle, is strongly convoluted for its greater proximal part but simply arcuate and a little wider at the distal end. The genital atrium opens at the margin, about half as far from the anterior as from the posterior end of the proglottis, irregularly on right or left.

The bilobed ovary at the posterior end of the proglottis varies from 0.08 mm to 0.15 mm in length and from 0.57 mm to 1.25 mm in breadth in mature or gravid segments. The beginning of the uterine duct is strongly convoluted

directly posterodorsal to the ovarial isthmus. The vitelline follicles form a narrow strand between the nerve cord and the testicular field. There are 20–30 uterine side pouches. When fully gravid the uterus breaks through the inner longitudinal muscle sheath in the median line both dorsally and ventrally and may eventually reach to the cuticle, particularly on the ventral side. The egg shell is exceedingly variable in size; in fully mature eggs the delicate outer membrane is up to 45 μ, the rather rigid embryonic shell 39 μ and the inner yolk membrane 30–33 μ in diameter respectively. The onchospheres are up to 18 μ in diameter and the embryonic hooks 9 μ long. The vagina opens immediately behind or in front of the cirrus, and has a sphincter at the opening. It passes mediad without crossing the cirrus pouch and then descends in the median line directly dorsal to the uterus; its proximal end is covered by cilia.

DISCUSSION. In anatomy this species resembles *Ophiotaenia lönnbergi* (Fuhrmann, 1896), but differs in the host. From *O. perspicua* La Rue, 1911, it can be distinguished chiefly by the number of testes.

Ophiotaenia japonensis n. sp.

SPECIFIC DIAGNOSIS. *Ophiotaenia* La Rue, 1911. Body up to 400 × 2.3 mm. Scolex 0.33–0.5 mm broad, with vestigial fifth sucker. Suckers 0.15–0.28 mm in diameter. Neck 6–13 × 0.31–0.37 mm. Testes 90–130 in number, partly extending beyond excretory stems. Cirrus pouch cylindrical to ovoid, 0.27–0.45 × 0.1–0.2 mm. Genital pores at end of anterior third of proglottis length or a little farther behind. Ovary 0.08–0.15 × 0.57–1.25 mm. Uterine pouches 20–30. Eggs variable in size; outer membrane up to 45 μ in diameter, embryonic shell 39 μ in diameter. Onchospheres up to 18 μ in diameter. Sphincter vaginae present.

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DIPHYLLOBOTHRIIDAE Lühe, 1910

2. *Diphyllobothrium serpentis* n. sp.

Two gravid specimens were obtained from the intestine of Formosan *Naja naja atra*. The type is 115 mm long by 2.82 mm broad, while the paratype cut into pieces is 4.0 mm in maximum breadth. The scolex is about 1.0 mm long and has well developed surficial bothria. There is a short neck. The proglottides are broader than long for the greater part, only the last few being quadrate or a little longer than broad; their posterior borders slightly overlap the succeeding segment. The cuticle is 6 μ thick. The subcuticular cells form a compact layer about 25–30 μ thick. The inner longitudinal muscle sheath is fairly well developed. The nerve cord lies about one third the proglottis breadth from the lateral margin or a little more outward. There are several longitudinal excretory vessels connected with each other by transverse commissures; the most conspicuous stem lies a little further outward than the

nerve cord. The most medial vessel runs on either side of the cirrus pouch, uterus and ovary.

The medullary testes, 210–230 in number, are distributed in two lateral fields uniting in front. The vas deferens is coiled in the med'an field dorsal to the distal end of the vagina. The vesicula seminalis enclosed in a thick muscular pouch is 0.1–0.125 mm in transverse diameter and has a very conspicuously villiform epithelium. The muscular cirrus pouch is 0.16–0.23 mm broad. The thin-walled ductus ejaculatorius enclosed in the cirrus pouch may be dilated with spermatozoa. The genital atrium opens outside by a transverse slit 0.15–0.18 mm broad.

Fig. 25

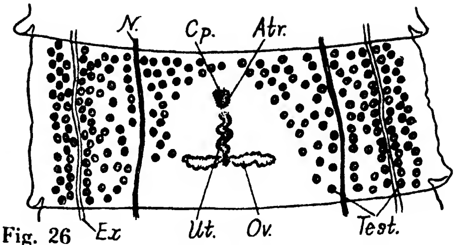

Fig. 24

Fig. 26

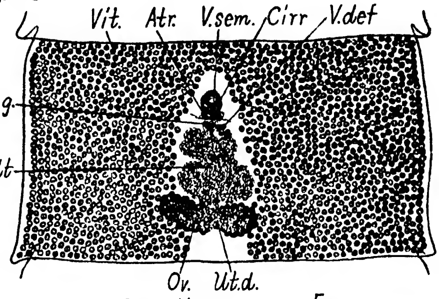

Fig. 27

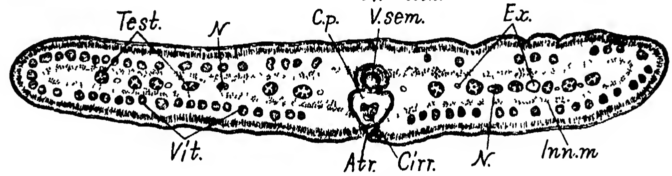

Fig. 24–27. *Diphyllobothrium serpentis.*
Fig. 24. Scolex 1.0 mm long; surficial view.
Fig. 25. Immature segment 2.5 mm broad; ventral view.
Fig. 26. Gravid segment 3.5 mm broad; ventral view.
Fig. 27. Transverse section of mature segment at level of genital pore.

The ovary with an irregular outline is 0.27 mm long by 0.85 mm broad in the last segments. The germiduct arising from the oocapt soon unites with the short very narrow ductus seminalis and then with the vitelline duct, which forms a small reservoir before joining the germiduct. The shell gland is rather poorly developed. The gravid uterine coils, 4–6 in number, form a relatively small, compact mass. The uterine pore lies about 0.12 mm behind the atrial aperture in the first gravid segments, only slightly to one side of the median line; in fully gravid segments it cannot be recognized in surface view. The oval, light brown, thin-shelled eggs are $54\text{–}61 \times 33\text{–}42\,\mu$; the contained ova are not segmented. The vitelline follicles occupy the entire cortical parenchyma except the median area occupied by the genital complex; they are continuous across the median line in front of the cirrus pouch. The vagina opening at the base of the genital atrium passes backward in a sinuous course on the ventral side of the vas deferens and uterus and forms a strongly recurved receptaculum seminis before leading into the ductus seminalis.

DISCUSSION. This worm is the first *Diphyllobothrium* from reptiles. There is no doubt that it represents a new species, though it bears a close resemblance to the known members of the genus.

Diphyllobothrium serpentis n. sp.

SPECIFIC DIAGNOSIS. *Diphyllobothrium* Cobbold, 1858. Body 115×4.0 mm or larger. Scolex about 1.0 mm long, with well developed bothria. Testes 210–230 in number, uniting in front of cirrus pouch. Vesicula seminalis 0.1–0.125 mm broad. Cirrus pouch 0.16–0.23 mm broad. Ovary 0.27×0.85 mm. Uterine coils 4-6, compact. Uterine pore definitely posterior to atrial aperture, only slightly to one side of median line. Eggs oval, light brown, thin-shelled, 54–61×33–42 μ. Vitellaria of two sides continuous in front of cirrus pouch.

Habitat. Small intestine of *Naja naja atra* (Cantor).

Locality. Formosa.

Type and paratype in my collection.

ABBREVIATION USED IN FIGURES

Atr. atrium
Cirr. cirrus
C. p. cirrus pouch
D. sem. ductus seminalis
D. v. dorsal excretory vessel
Ex. excretory stem
G. d. germiduct
Inn. m. inner longitudinal muscle
N. nerve cord
Ov. ovary
R. sem. receptaculum seminis
Sh. gl. shell gland
Test. testis
Tr. comm. transverse excretory commissure
Tr. m. transverse muscle
Ut. uterus
Ut. d. uterine duct
Vag. vagina
V. def. vas deferens
Vit. vitelline gland
Vit. d. vitelline duct
V. s. vesicula seminalis
V. v. ventral excretory vessel

8. Studies on the Helminth Fauna of Japan

Part 8. Acanthocephala, I

By Satyû YAMAGUTI

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CONTENTS

INTRODUCTION

Earlier German authors have brought to light many anatomical details of taxonomic importance in the genital organs of Acanthocephala, but unfortunately their findings have not been utilized by subsequent systematists.

The muscular cap of the genital bursa (Bursalsack of Leuckart, Bursalmuskelkappe of Kaiser and others) has usually a pair of saccular anterior diverticula and many digitiform posterior rays. As Leuckart stated (Die mensch-

lichen Parasiten, II. Bd., 1876, p. 783), these rays are variable in number and shape, but since they are constant within the same species it is very desirable to determine, if possible, their size, shape and number.

The papilliform projections (Gefühlspapillen of Leuckart) on the inner surface of the muscular cap also deserve special attention, because they may be entirely absent or strongly developed (e. g. in *Rhadinorhynchus katsuwonis* Harada, 1928).

The Markbeutel, which I propose to call "Säfftigen's pouch" in honor of the discoverer, is of no great importance from the taxonomic point of view. The cement gland provides an important clue to generic determination, though it may sometimes vary in number according to individuals (e. g. in *Arhythmacanthus fusiformis* mihi). The giant muscle cells around the ductus ejaculatorius may differentiate into a definite sphincter and constitute a good generic character (e. g. in *Acanthocephaloides* Meyer, 1931).

The anatomy of the female genitalia should also be taken into consideration; the uterine bell may be different in structure according to genera and sometimes substituted by the modified uterus. The vagina may form a distinct bulb at its posterior end (e. g. in *Echinorhynchus* Zoega). The vaginal sphincters may be single or double; in the latter case they may lie one directly in front of the other or form an outer and an inner sphincter of Leuckart. Measurements should be made, if possible, on each of the three shells as well as on the embryo of fully matured eggs. Unless otherwise stated, the measurements given in this paper were made in water on specimens fixed in alcohol.

ECHINORHYNCHIDAE Cobbold, 1879

1. *Echinorhynchus gadi* Zoega in Müller, 1776

This species is very common in *Gadus macrocephalus* Tilesius and *Theragra chalcogramma* (Pallas) from the Sea of Japan. The worm was described by Lühe and also by Bieler with special reference to its male genitalia, so that only measurements on my material are given in the following.

The largest male at my disposal is 13.6 mm long by 0.85 mm broad, while the largest gravid female is 39 mm long by 1.21 mm broad. The proboscis is 0.57–0.71 × 0.2–0.26 mm and its sheath 1.5–1.63 × 0.31–0.35 mm. The proboscis hooks are in 19–20 longitudinal rows of 12–15 each. The lemniscus is half as long as the proboscis sheath when retracted, but may be longer than the latter when extended. The numerous large muscle cells on the inner surface of the body wall are very prominent. The testes and the cement glands may be up to 1.42 mm and 0.61 mm long respectively. The strongly muscular genital sheath is 30–54 μ thick. The uterine bell is 0.17–0.25 mm long and the uterus 0.52–1.35 mm long. The vaginal sphincter and the posterior vaginal bulb are 60–130 μ in diameter. The fusiform outer egg shell is 111–138 × 24–30 μ; the middle, prolonged at the poles, 93–111 × 17–21 μ; the elliptical inner, more or less thickened at the poles, 57–66 × 15–17 μ; the ellipsoidal embryo

49–54 × 12–15 μ.

The following specimens obtained from the same locality are probably referable to this species, since they agree in every essential particular with the specimens from gadids.

Hosts	Specimens	Lgth. of trunk in mm	Lgth. of proboscis in mm	Numb. of proboscis hooks	Lgth. of proboscis hooks in μ	Size of eggs in μ
Sciaena schlegeli	♀	20	0.77	19 × 13–14	50–57	immature
Cyclogaster owstoni	♀	25	0.58	20 × 12–13	39–69	69–75 × 13–15
”	♂	9.5	0.43	”	33–51	
Sterolepis ischinagi	♀	20	0.55	18 × ?	50–63	75–84 × 14–20
Lotella physis	♂	5.6–5.8	0.53	18 × 12–14	36–60	
”	♀	15.5	0.62	”	40–63	immature
Bothrocara zesta	♂	4.3	0.6	18 × 14	39–69	
Arctoscopus japonicus	♂	5.5	0.56	18 × ?	36–63	
”	♀	7.0	0.73	18 × ?	45–63	not fully mature
Hexagrammos otakii	♂	7.56	0.5	19 × 14	33–54	
”	♀	19.0	0 5	”	45–66	immature
Limanda angustirostris	♂	6.0	0.55	19 × 14	50–66	

Fujita found this worm in the intestine of *Oncorhynchus keta* Walbaum from Niigata Prefecture but states that this host should be looked upon as accidental.

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2. *Echinorhynchus cotti* n. sp.

Description. A number of adults were obtained from the small intestine of *Cottus pollux* Günther.

Male. The cylindrical proboscis, 0.42–0.5 × 0.11–0.15 mm, has 16–18 longitudinal rows of about 13 hooks each, the largest of which is 45 μ long. There is a very short neck. The trunk, 3.75–5.5 × 0.44–0.63 mm, has a very complex lacunar system. The nuclei of the hypodermis are fused with their neighbors in a dendritic pattern. The large muscle cells lining the body wall project very prominently into the body cavity, as in *Echinorhynchus gadi*. The thick, double-walled proboscis sheath, 0.63–0.9 × 0.15–0.24 mm, contains 0.2–0.25 mm in front of its base an elliptical cephalic ganglion. The two retractors arising from the posterior end of the proboscis sheath are attached to the body wall at the level of the anterior testis. The more or less crumpled lemnisci do not extend farther backwards than the proboscis sheath. The oval to elliptical testes, 0.38–0.72 × 0.26–0.38 mm, lie one directly or some distance

behind the other, the anterior being constantly in the anterior half of the trunk. The 5–6 (usually 6) ovoid cement glands, 0.18–0.37 mm long, are arranged directly tandem or slightly overlapping each other. The Säfftigen's pouch is 0.44–0.5 mm long. The genital sheath enclosing the Säfftigen's pouch, vesicula seminalis and terminal cement ducts is very muscular, as in *Echinorhynchus gadi*. The muscular cap of the bursa has about 20 digitiform rays, each ending with a small rod-shaped projection slightly enlarged at the tip. The genital pore is terminal.

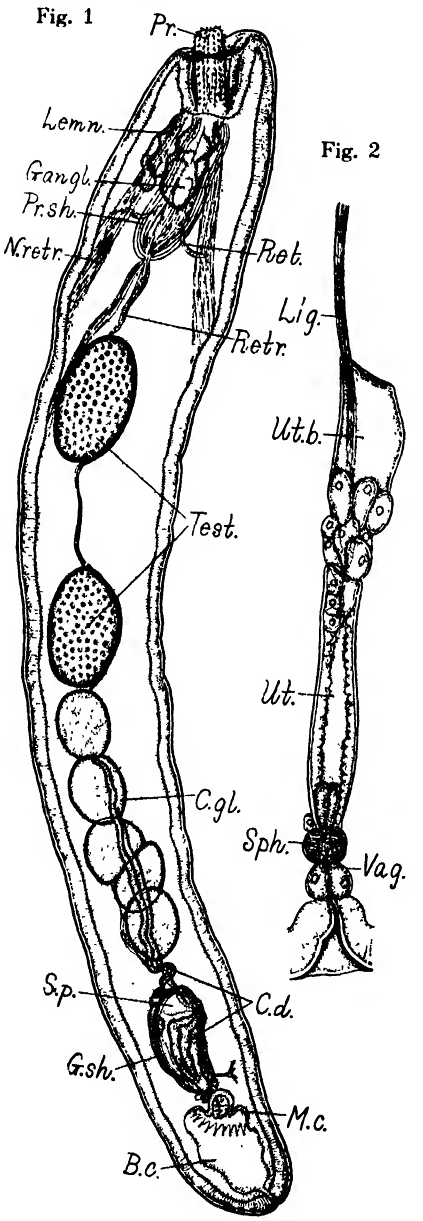

Fig. 1–2. *Echinorhynchus cotti.*
Fig. 1. ♂, 5.75 mm long.
Fig. 2. Female genital ducts.

Female. The proboscis, 0.5–0.63 × 0.12–0.15 mm, bears 18–20 longitudinal rows of hooks measuring up to 51 μ in length. The proboscis sheath is 0.75–1.1 × 0.23–0.25 mm. The elliptical cephalic ganglion, 0.12–0.15 mm long, lies 0.25–0.3 mm in front of the posterior end of the proboscis sheath. The trunk is 5.7–10.0 mm long and 0.7–1.0 mm in maximum breadth at the anterior part. The uterine bell is about 0.22 mm long by 0.11 mm wide. The uterus is 0.58–0.7 × 0.05–0.075 mm. The relatively small vaginal sphincter is 60–75 μ in diameter. The vagina forms at its distal end a large bulb 72–90 μ broad. The genital pore opens terminally. The delicate outer egg shell is 114–132 × 20–22 μ, the middle with conspicuous polar prolongations 108–129 × 15–19 μ, and the elliptical inner 65–72 × 13–16 μ. The embryo is 54–60 × 12–14 μ.

Discussion. From the position of the cephalic ganglion, the arrangement of the cement glands, the very muscular genital sheath, the structure of the female genital ducts, etc, it is certain that this worm belongs to *Echinorhynchus* Zoega but cannot be compared

with the old species of this genus from *Cottus*, such as *E. annulatus* Gmelin, 1790, *E. gobii* Viborg, 1795, *E. lineolatus* O. F. Müller, 1779, etc, because these are too meagerly described.

Echinorhynchus cotti n. sp.

SPECIFIC DIAGNOSIS. *Echinorhynchus* Zoega in Müller, 1776. Proboscis 0.42–0.63 × 0.11–0.15 mm, with 16–20 longitudinal rows of about 13 (?) hooks each, measuring up to 51 μ in length. Neck very short. Trunk 3.75–5.5 × 0.44–0.63 mm in males, 5.7–10.0 × 0.7–1.0 mm in females, with dentritic hypodermal nuclei. Proboscis sheath 0.63–1.1 × 0.15–0.25 mm, containing at some distance (0.2–0.3 mm) in front of its base, a cephalic ganglion, 0.12–0.15 mm long. Lemnisci usually not extending backwards beyond posterior end of proboscis sheath. Testes 0.38–0.72 × 0.26–0.38 mm, directly tandem or separated, anterior one constantly in anterior half of trunk. Cement glands 5 or more usually 6, ovoid, 0.18–0.37 mm long. Muscular cap with about 20 rays. Vaginal sphincter 60–75 μ in diameter. Vagina forming at its distal end a large bulb 72–90 μ broad. Outer egg shell 114–132 × 20–22 μ, middle 108–129 × 15–19 μ, inner 65–72 × 13–16 μ. Embryo 54–60 × 12–14 μ.

Habitat. Small intestine of *Cottus pollux* Günther.

Locality and date. Siga Prefecture; March 26, 1928.

Type and paratypes in my collection.

3. *Acanthocephalus nanus* Van Cleave, 1925

The material on which the following description is based, was obtained on May 25, 1932, from the small intestine of *Diemyctylus pyrrhogaster* near my former residence at Hanazono, Kyoto. The males are 3.8–5.33 mm long, while the females are 6.2–10.0 mm long. The short cylindrical proboscis, 0.31–0.5 × 0.15–0.18 mm, has 11 to 14 longitudinal rows of 7 hooks each, of which the largest are 57–69 μ long and the smallest basal 45–48 μ long. The proboscis sheath is 0.5–0.75 mm long by 0.11–0.22 mm broad; Van Cleave's measurement of it (0.18 mm !) is obviously erroneous, because it is constantly longer than the proboscis. The lemnisci are a little longer than the proboscis. The oval testes lying one directly behind the other at about the middle of the body are 0.31–0.55 long by 0.2–0.43 mm broad in flattened mounts, in which the oval cement glands are 0.2–0.25 × 0.15–0.18 mm each, the Säfftigen's pouch is 0.5–0.53 × 0.15–0.21 mm and the muscular cap of the genital bursa, 0.21 mm broad, has about 24 digitiform rays; these dimensions are much exaggerated by pressure. The outermost egg shell is 84–102 × 15–18 μ, the middle with polar prolongations 76–93 × 12–15 μ, and the embryo 42–57 × 9–11 μ; the innermost shell being closely applied to the embryo could not be measured with certainty.

On June 1, 1930, a mature male and a mature female were found in the small intestine of *Rana rugosa* from the same locality where the newt acanthocephalan described above was obtained. The male is 3.5 mm long by 0.5 mm broad, while the female is 5.6 mm long and just as broad as the male. The partly inverted proboscis of the male has 12 longitudinal rows of hooks 45–51 mm long, while that of the female, 0.28 × 0.13 mm, has 13 rows of 6 hooks each, measuring 45–57 μ long. The neck is lacking. The proboscis sheath is 0.45 mm long in the female and 0.62 mm in the male and the lem-

nisci are about 0.5 mm long in both. The anterior testis is 0.38 × 0.3 mm and the posterior 0.37 × 0.26 mm, both lying directly tandem in the middle third of the body. The vasa efferentia show two or three spindle-shaped dilatations in their course. The vesicula seminalis, 0.23 mm long, lies dorsal to the posterior half of the Säfftigen's pouch 0.35 mm long. The six pear-shaped cement glands are 0.18–0.3 mm long. The embryos which are not yet fully developed are 42 μ long by 9 μ broad.

As is evident from the above description, the specimens from *Rana rugosa* agree with those from *Diemyctylus pyrrhogaster*, though somewhat different in the number of proboscis hooks. In both the middle egg shell with polar prolongations are just as long as the embryo in Van Cleave's specimens. If Van Cleave is correct in his measurements of embryos, my worm cannot be assigned to his species, but this is very improbable.

Life History

Asellus aquaticus collected at the same time from the pond from which the newt acanthocephalan was obtained harbored in the body cavity the larvae of this species in various stages of development. The largest males are 2.75–3.1 mm long; the proboscis, 0.35–0.37 × 0.14–0.15 mm, has 11–12 longitudinal rows of 7 hooks each, 39–51 μ long; the proboscis sheath is about 0.6 mm long and the lemnisci 0.65 mm long; the oval testes, 0.31–0.37 × 0.21–0.23 mm, lie one behind the other at the posterior end of the middle third of the body, with a maximum interval of 0.11 mm; the elongate vesicula seminalis is small, but the six cement glands, the Säfftigen's pouch and the muscular bursa cap, with 20–24 digitiform rays, are well developed.

In the largest female 4.8 mm long, the proboscis is 0.4 mm long and entirely inverted into its sheath, which is 0.725 mm long. The proboscis hooks in 11 longitudinal rows are about 57 μ in maximum length. The uterine bell and the uterus are rudimentary. The small follicular germ balls are numerous in the body cavity.

Though not experimentally verified, it is certain that the larval acanthocephalan found in the body cavity of *Asellus aquaticus* belongs to *Acanthocephalus nanus* Van Cleave, 1925.

4. *Acanthocephalus gotoi* Van Cleave, 1925

According to Van Cleave, the proboscis is armed with 15 to 17 (or more ?) longitudinal rows of about 15 hooks each, but in my specimens from *Anguilla japonica* from various localities, there are 15–17 rows of 12 hooks each, and in immature ones from the intestine of *Mogurnda obscura* and *Parasilurus asotus* from Lake Ogura, 16–17 rows of 12 hooks each, the largest being 48–57 μ long.

5. *Acanthocephalus artatus* Van Cleave, 1925

A number of specimens were found on August 19, 1927, in the anterior

portion of the small intestine of *Rana japonica* from the same Prefecture where Van Cleave's type was collected.

The body is up to 10 × 1.1 mm in the male and 15.0 × 1.5 mm in the female. The stout proboscis, slightly tapering anteriorly, is 0.3–0.33 mm long by 0.15–0.2 mm broad in the male and 0.4–0.5 mm long by 0.25–0.37 mm broad in the female, and bears 14–15 longitudinal rows of five hooks each, measuring 93–105 μ in the male and 100–125 μ in the female. The proboscis sheath is 0.56–0.7 × 0.25–0.35 mm in the male and 0.65–0.9 × 0.38–0.5 mm in the female. The lemnisci are somewhat longer than the proboscis sheath. There is a short neck up to 0.15 mm long.

The oval testes, up to 0.88 × 0.65 mm, lie directly tandem behind the middle of the body; one of them may sometimes be greatly atrophied.

The outer egg shell is 96–102 × 24–27 μ, the thick middle 72–78 × 18–21 μ and the inner 51–54 × 15–18 μ. Within the outer shell there are numerous longitudinal filaments. The embryo is 45–51 × 13–15 μ.

6. *Acanthocephalus minor* n. sp.

The males are 1.5–2.0 mm long by 0.5 mm broad, while the females are 2.3–3.1 mm long by 0.7–0.75 mm broad. The proboscis, 0.34–0.5 × 0.14–0.2 mm, bears 14–15 longitudinal rows of 7–9 simple hooks each, the largest hooks

Fig. 5

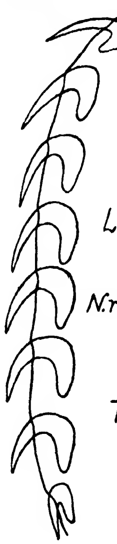

Fig. 3

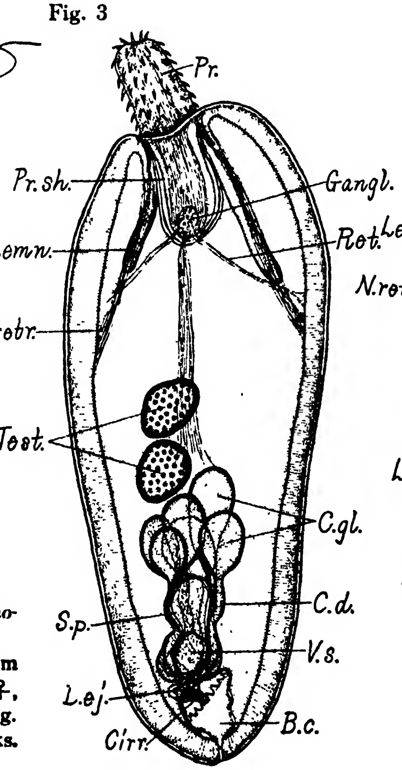

Fig. 4

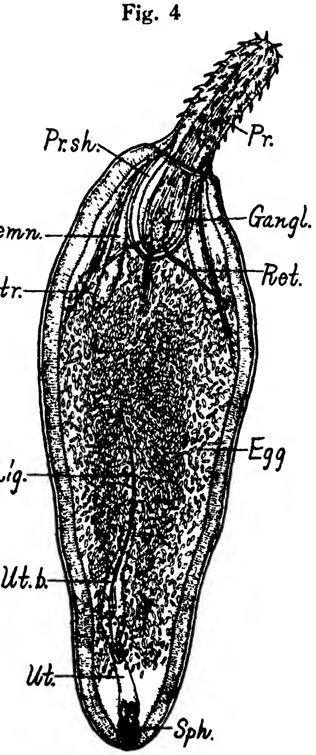

Fig. 3–5. *Acanthocephalus minor*. Fig. 3. ♂, 2.5 mm long. Fig. 4. ♀, 3.0 mm long. Fig. 5. Proboscis hooks.

measuring 60–72 μ in male and 68–87 μ in female, and the smallest hooks 42–60 μ and 54–66 μ respectively.

There is a very short neck 0.06–0.09 mm long. The proboscis sheath is 0.32–0.53 mm long in the male and 0.4–0.55 mm long in the female, and contains at the base a large cephalic ganglion measuring about 87 × 57 μ. The lemnisci are longer than the proboscis sheath and up to 0.58 mm long. The oval testes, 0.16–0.28 × 0.15–0.23 mm, lie obliquely tandem at the junction of the middle with the posterior third of the body. The six oval to pyriform cement glands are closely massed together directly behind the posterior testis and partly overlap it.

The outer egg shell is 75–90 × 11–18 μ and the middle with polar prolongations 63–78 × 9–11 μ. The embryos could not be measured accurately.

Habitat. Small intestine of *Parasilurus asotus*.

Locality and date. Toyama Prefecture; May 17, 1932.

Type and paratypes in my collection.

This species differs from *A. lucii* (Müller, 1779) with the same number of proboscis hooks chiefly in the size of the body and eggs.

Fig. 6

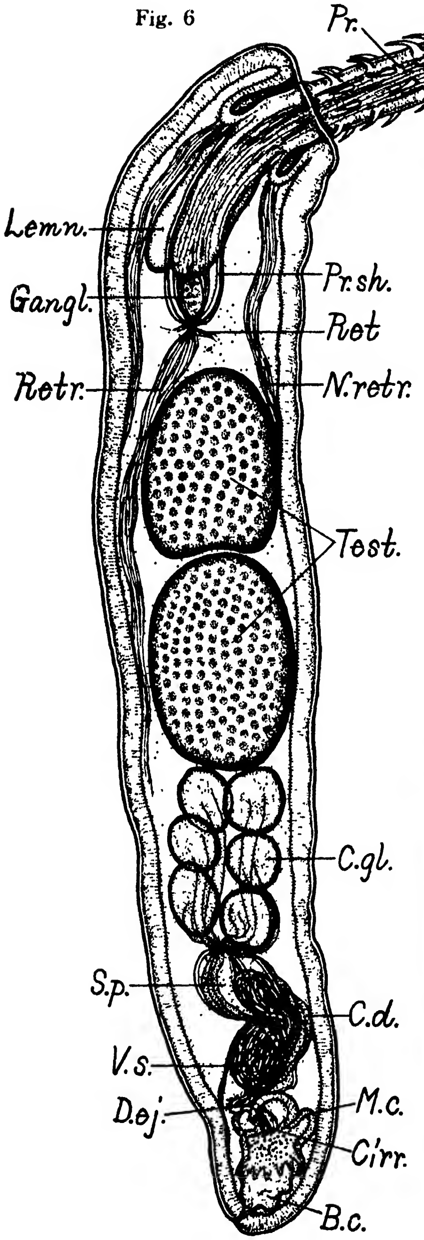

Fig. 7

Fig. 8

Fig. 6–8. *Acanthocephalus opsalichthydis*.
Fig. 6. ♂, 2.77 mm long.
Fig. 7. Proboscis hooks.
Fig. 8. Egg, 103 × 17 μ.

7. *Acanthocephalus opsalichthydis* n. sp.

DESCRIPTION. This worm parasitizes various freshwater fishes. The male type from *Opsalichthys uncirostris* is 2.77

mm long by 0.42 mm broad, while the female type is 5.0 mm long by 0.8 mm broad. The following description is based on the somewhat flattened alcoholic specimens from *Opsalichthys uncirostris.* The cylindrical proboscis, 0.42–0.65 × 0.088–0.13 mm, bears 9 longitudinal rows of 5–7 hooks each, the stout root having an anterior prolongation; the largest hooks are 84–120 μ long and the smallest basal 27–51 μ long. There is a short neck. The proboscis sheath is 0.37–0.48 × 0.12–0.13 mm. The lemnisci are usually a little shorter than the proboscis sheath. The oval testes, 0.4–0.43 × 0.27–0.35 mm, lie directly tandem at about the middle of the body. The small vesicula seminalis lies postero-dorsal to the Säfftigen's pouch, the proximal end of which is about 0.13 mm in diameter. The oval cement glands, 0.1–0.14 mm long, lie directly behind the posterior testis in two longitudinal rows of three each. The muscular bursa cap bears numerous small papillae on its inner surface.

The fusiform outer egg shell containing filaments is 93–114 × 13–17 μ, the middle with conspicuous polar prolongations 78–99 × 12–14 μ, and the inner 58–63 × 10–12 μ. The embryo is 51–56 × 9–10 μ.

The lacunar system of the trunk consists of two longitudinal stems and numerous anastomosing transverse branches.

The dimensional variations and hosts other than *Opsalichthys uncirostris* are shown in the following table.

Hosts	Body length (in mm)	Proboscis length (in mm)	Length of largest proboscis hook (in μ)	Length of proboscis sheath (in mm)	Length of testes (in mm)
Zacco platypus	♂ 2.43	0.25	81	0.47	0.31–0.35
,,	♀ 2.65	0.25	138	0.41	–
Hemibarbus barbus	♂ 2.35	0.28	84	0.53	0.37
,,	♀ 3.4–5.2	0.32–0.5	120–150	0.44–0.75	–
Hymenophysa curta	♂ 1.83–2.16	0.28–0.36	78	0.38–0.48	0.28–0.42
,,	♀ 3.8	inverted	120	0.65	–
Pseudorasbora parva	♂ 2.57	0.37	72	0.34	?
,,	♀ 5.0	0.38	90	0.62	–
Cyprinus carpio	♀ 2.6	inverted	150	0.66	–
Parasilurus asotus	♂ 2.57	0.41 (stretched)	93	0.45	0.32
,,	♀ 3.38	0.48 (stretched)	141	0.42	–

It is interesting to note that the very numerous specimens obtained on November 9, 1931, from *Parasilurus asotus* are all immature; this is probably due not merely to seasonal influence.

This species is distinguished from all known members of the genus by the proboscis hooks.

Acanthocephalus opsalichthydis n. sp.

Specific Diagnosis. *Acanthocephalus* Koelreuter, 1771. Male 1.83–2.77 mm long, 0.65 mm in maximum breadth. Female 2.6–5.0 mm long, 0.8 mm in maximum breadth. Proboscis cylindrical, 0.25–0.65 mm long, with 9 longitudinal rows of 5–7 hooks each; largest hooks 72–150 μ long, smallest basal 15–51 μ. Proboscis sheath 0.34–0.75 mm long. Lemnisci usually a little shorter than proboscis sheath but may be occasionally longer. Testes oval, 0.28–0.43 mm long,

directly tandem at about middle of body. Outer egg shell containing filaments 93–114×13–17 μ, middle with polar prolongations 78–99×12–14 μ, inner 58–63×10–12 μ; embryo 51–56 × 9–10 μ.

Habitat. Small intestine of *Opsalichthys uncirostris* (type host), *Zacco platypus, Hemibarbus barbus, Hymenophysa curta, Pseudorasbora parva, Cyprinus carpio, Parasilurus asotus.*

Localities. River Yodo (type locality); Lake Ogura; Lake Biwa.

Dates. Oct. 16, 1929 (type date); August 18, 1927; March 26, 1928; Oct. 26, Nov. 3 & 9, 1931.

Type and paratypes in my collection.

Literature cited

Van Cleave, H. J. Acanthocephala from Japan. Parasit., Vol. 17, 1925, p. 149–154.

Fig. 9

Fig. 10

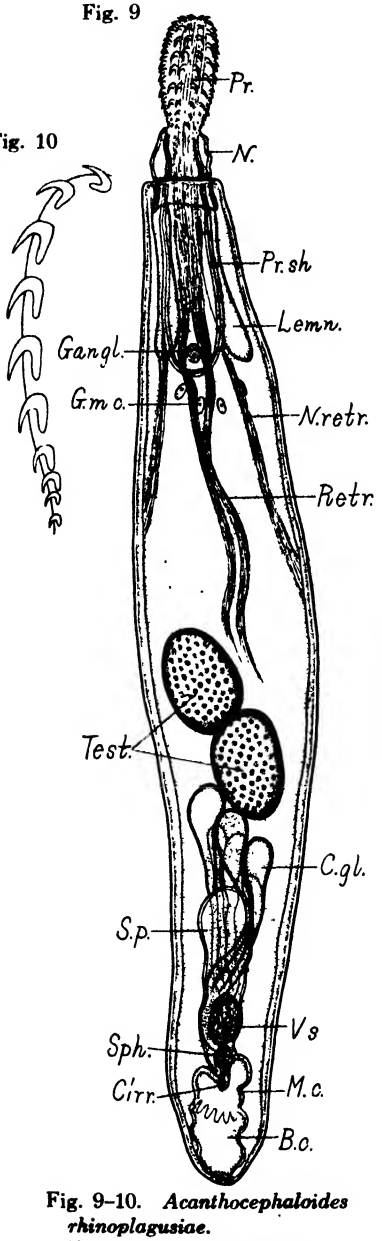

Fig. 9–10. ***Acanthocephaloides rhinoplagusiae.***
Fig. 9. ♂, 3.1 mm long.
Fig. 10. Proboscis hooks.

8. *Acanthocephaloides rhinoplagusiae* n. sp.

A number of this worm were found in the intestine of *Rhinoplagusia japonica* (Temm. et Schleg.) from the Inland Sea and Toyama Bay.

Male. The cylindrical proboscis, 0.3–0.37 mm long by 0.11–0.13 mm broad, bears 14 longitudinal rows of 10 hooks each, the largest middle 42–57 μ long and the smallest basal 16–18 μ long. The unarmed neck is 0.15–0.2 mm long. The double-walled proboscis sheath is 0.38–0.65 mm long and 0.13–0.17 mm broad near the base, which contains the cephalic ganglion. The finger-like lemnisci are a little shorter than the proboscis sheath but may be as long or even slightly longer. The smooth, almost cylindrical or slightly spindle-shaped trunk is 2.0–3.1 mm long and 0.5 mm in maximum breadth at about its middle. The oval testes, 0.18–0.28 × 0.13–0.18 mm, lie one behind the other at the posterior end of the middle third of the trunk, slightly overlapping each other. The vasa efferentia are much dilated and twisted. The elongate pear-shaped cement glands are in two groups of three each directly behind the posterior testis, and continue imperceptibly into their ducts, of which three on each side unite at the level of the anterior end of the

vesicula seminalis into a relatively wide common duct. The Säfftigen's pouch, 0.12–0.13 mm broad, lies posterodorsal to the cement glands. The ductus ejaculatorius with a thick muscular wall has a bulbous sphincter 48–54 μ broad at its proximal end. The muscular bursa cap has about 14 digitiform rays. The genital bursa is about 0.12 mm broad in the type figured. Behind the proboscis sheath there are four large nuclei of parietal muscle cells, measuring $36–45 \times 15–20\ \mu$ and containing each a nucleolus 5–6 μ in diameter.

FEMALE. The cylindrical proboscis, $0.38–0.5 \times 0.11–0.2$ mm, has the same number of hooks as in the male, the largest middle 54–63 μ long and the smallest basal 18–24 μ long. The neck is up to 0.28 mm long. The proboscis sheath is 0.61–0.98 mm long by 0.13–0.22 mm broad. The two lemnisci are slightly shorter than the proboscis sheath. The unarmed trunk is 2.5–6.4 mm long by 0.5–0.8 mm in gravid specimens. The eggs filling the body cavity are $42–63 \times 9–12\ \mu$; the middle shell has conspicuous polar prolongations.

DISCUSSION. This worm differs markedly from *Acanthocephalus* species in the shape of cement glands and in the presence of a bulbous sphincter. I have therefore assigned it to *Acanthocephaloides* Meyer, 1931, though the type of this genus is not well known.

Acanthocephaloides rhinoplagusiae n. sp.

SPECIFIC DIAGNOSIS. *Acanthocephaloides* Meyer, 1931. Proboscis $0.3–0.5 \times 0.11–0.2$ mm, almost cylindrical, with 14 longitudinal rows of 10 hooks each; largest middle hooks 42–63 μ long and smallest basal 16–24 μ long. Neck unarmed, 0.15–0.28 mm long. Trunk smooth, 2.0–6.4 mm long, up to 0.8 mm broad. Proboscis sheath $0.38–0.98 \times 0.13–0.22$ mm. Lemnisci finger-like, nearly as long as proboscis sheath. Testes oval, $0.18–0.28 \times 0.13–0.18$ mm, at posterior end of middle third of trunk. Ductus ejaculatorius with bulbous sphincter at its proximal end. Muscular bursa cap with about 14 digitiform rays. Eggs $42–63 \times 9–12\ \mu$, with conspicuous polar prolongations in midde shell.

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Meyer, A. Die Stellung des Genus *Heterosentis* Van Cleave, 1931 im Acanthocephalensystem. Zool. Anz., Bd. 94, 1931, p. 258.

9. *Longicollum pagrosomi* n. g. n. sp.

DESCRIPTION. Immature worms of this species have been found in various marine fishes, such as *Trachurus trachurus* Linné, *Epinephelus akaara* (Temm. et Schl.), *Parapristipoma trilineatum* Thunberg, *Gymnocranius griseus* (Temm. et Schl.), *Sparus longispinis* (Temm. et Schl.), *Hoplognathus fasciata* (Temm. et Schl.), *Sillago sihama* (Forksål), *Halichoeres poecilopterus* (Temm. et Schl.), *Siganus fuscescens* (Houttuyn), etc, while mature ones, on which the following description is based, occur with their proboscis imbedded in the wall of the initial portion of the large intestine of *Pagrosomus unicolor* (Quoy et Gaimard).

The short cylindrical proboscis is rounded in front and up to 0.9–1.3 mm long and 0.5–0.6 mm broad. The proboscis hooks are 45–60 μ long and in

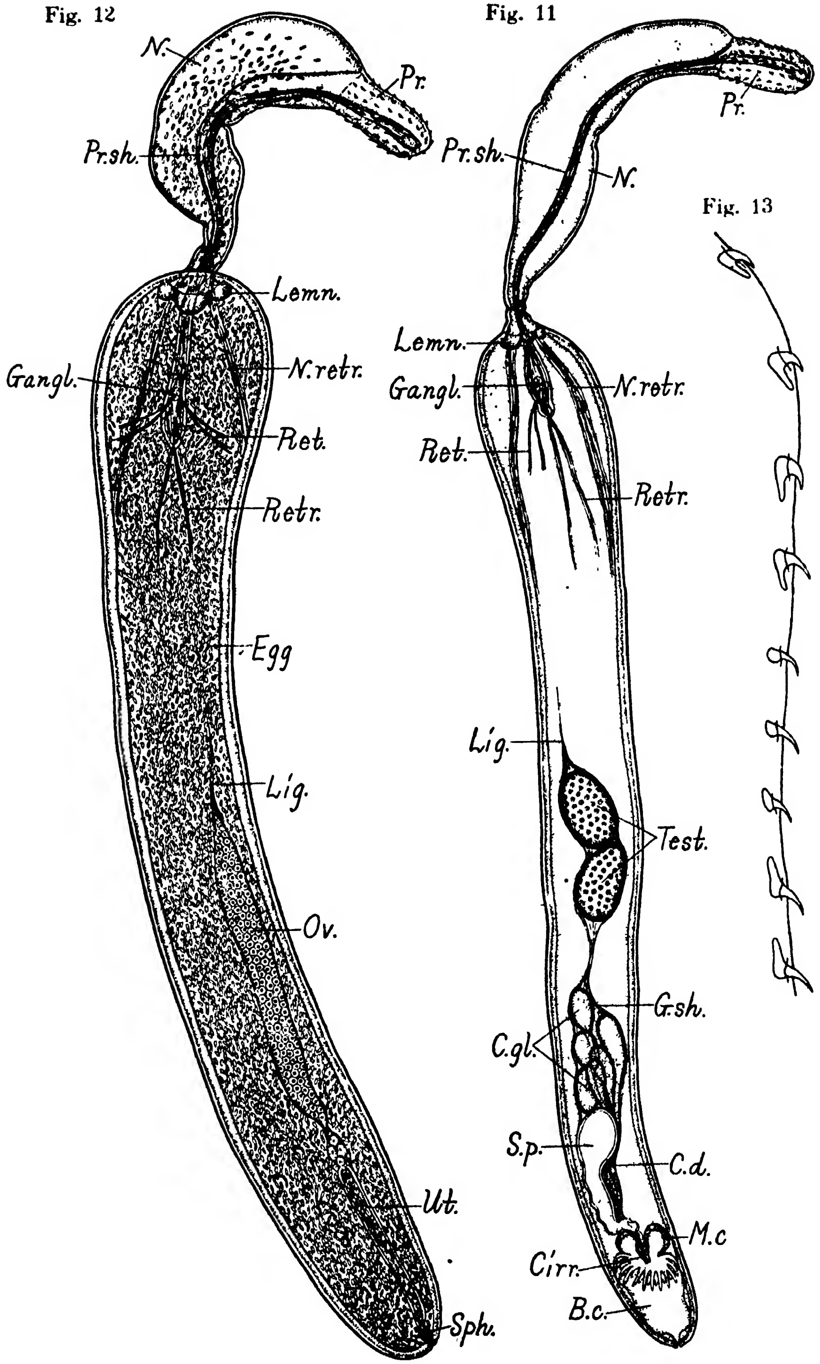

Fig. 11–13. *Longicollum pagrosomi.*
Fig. 11. ♂, 17.2 mm long. Fig. 12. ♀, 17.8 mm long. Fig. 13. Proboscis hooks.

11–15 longitudinal rows of 9–12 each; the anterior hooks are only slightly shorter but more strongly recurved than the posterior ones; the rod-shaped root is greatly reduced in the middle hooks but becomes longer again and is directed forwards in the posterior hooks. The neck, up to 5.0 × 1.5 mm, is more or less spirally twisted and conspicuously expanded on the convex side with or without eggs, but does not form a bulla in the true sense of the word. The almost cylindrical trunk, 12–17 mm long or longer and tapering slightly toward the posterior end, has a complex reticular system of lacunae. The rather slender proboscis sheath arising from the posterior end of the proboscis, lies in the axis of the spiral neck, thus taking the shortest way to the trunk, into which it extends for a distance of 1.0–1.6 mm; it has a double wall of circular muscles, an outer slightly thinner layer consisting of coarse fibers and an inner of very closely set fine fibers. At the anterior end of the proboscis retractor there is a large, oval to elliptical mass of unknown nature, which is enclosed in a thin capsule and attached to the inner surface of the proboscis apex. The large oval ganglion lies in the fusiform swelling of the proboscis sheath, 0.3–0.6 mm in front of its posterior end. The completely bifid retinaculum, up to 0.75 mm long, arises distinctly ahead of the retractor of the proboscis sheath which is 0.7–1.5 mm long. The lemnisci are reduced to a lobed collar around the proboscis sheath at its entrance into the trunk. The retractor muscles of the neck are well developed. The lacunar system of the neck and trunk is finely reticular.

The elongate oval testes, up to 1.5 mm long, lie one directly behind the other at about the middle of the trunk or further behind. The vesicula seminalis is small. The six oval or elongate cement glands are closely arranged side by side or partly overlapping one another, immediately or some distance behind the posterior testis. The elongate Säfftigen's pouch with rounded anterior end is up to 1.5 mm long. The muscular bursa cap has two large anterior diverticula and 21 digitiform posterior rays. The copulatory bursa is well developed.

The elongate ovary, 3.8 mm in maximum length and enclosed in the ligament, lies just behind the middle of the trunk or a little farther posteriorly. There is no uterine bell. The uterus is very long and thick-walled, and has at its anterior end a group of numerous giant cells. The single vaginal sphincter is about 0.1 mm in diameter. The free eggs in the body cavity have a very delicate, deciduous outer membrane

Fig. 14

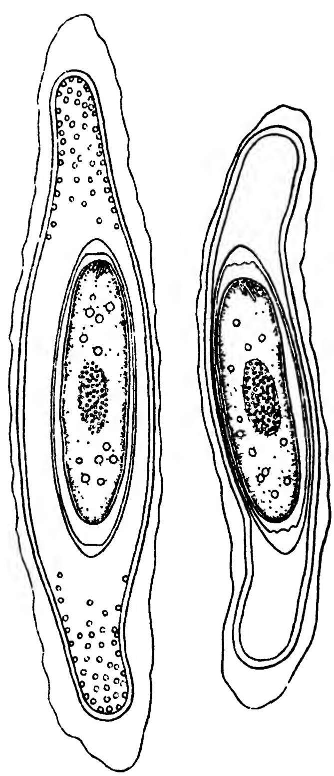

Fig. 14. Eggs of *Longicollum pagrosomi*, 123–156 × 21–28 μ.

measuring 123–156 × 21–28 μ; the thicker middle shell with more or less inconspicuous polar prolongations is 90–117 × 15–27 μ, and the relatively thick elliptical inner one with conspicuous polar thickenings 54–60 × 12–15 μ; the embryo, 42–48 × 10–12 μ, contains a distinctly differentiated entoblast in the middle and a few spines at one pole. It is interesting to note that numerous fine granules, probably of the same origin as the middle shell, are often found free within the middle shell or partly attached to its inner wall.

DISCUSSION. This genus bears a superficial resemblance to *Pomphorhynchus* Monticelli, but differs from it fundamentally in the position of the cephalic ganglion, in the absence of the "bulla", etc. I would assign my genus to Echinorhynchinae Travassos, 1919.

Longicollum n. g.

GENERIC DIAGNOSIS. Echinorhynchidae Cobbold, 1879; Echinorhynchinae Travassos, 1919. Proboscis short cylindrical, with hooks of different shapes. Neck unarmed, very long, more or less spiral, conspicuously expanded on convex side but not forming true bulla. Trunk elongate, nearly cylindrical, with reticular lacunar system. Proboscis sheath double-walled, extending into trunk for a short distance. Cephalic ganglion a little in front of base of proboscis sheath. Retinacula completely bifid. Short saccular lemnisci around proboscis sheath at its entrance into trunk. Testes directly tandem, equatorial or postequatorial. Six oval or elongate cement glands. Säfftigen's pouch elongate. Muscular bursa cap with two saccular anterior diverticula and numerous digitiform rays. Ovary elongate, postequatorial, enclosed in ligament. No uterine bell. Uterus long. Vagina with single sphincter. Eggs free in cavity of trunk and neck, with delicate outer, thick middle and very distinct inner shell. Parasitic in marine fishes.

Genotype. *Longicollum pagrosomi.*

Longicollum pagrosomi n. sp.

SPECIFIC DIAGNOSIS. *Longicollum:* with generic characters. Proboscis 0.9–1.3 × 0.5–0.6 mm. Proboscis hooks 45–60 μ long, in 11–15 longitudinal rows of 9–12 each. Neck up to 5.0 × 1.5 mm. Trunk 12–17 mm long or longer. Testes elongate oval, up to 1.5 mm long. Muscular bursa cap with 21 rays. Outer egg shell 123–156 × 21–28 μ, middle 90–117 × 15–27 μ, inner 54–60 × 12–15 μ; embryo 42–48 × 10–12 μ.

Habitat. Large intestine of *Pagrosomus unicolor* (Quoy et Gaimard). Immature in *Trachurus trachurus, Parapristipoma trilineatum, Gymnocranius griseus, Sparus longispinis, Hoplognathus fasciata, Sillago sihama, Halichoeres poecilopterus, Siganus fuscescens,* etc.

Localities. Inland Sea (type locality); Toyama Bay.

Dates. August 4, 1929 (type date); July to September, 1927–1932.

Type and paratypes in my collection.

10. *Tenuiproboscis misgurni* n. g. n. sp.

DESCRIPTION. Some ten mature specimens of this species were found firmly attached to the stomach wall of *Misgurnus fossilis* (Linné) from an unknown locality.

The almost filiform proboscis is 0.66–0.75 × 0.06–0.075 mm in the male and 1.6–1.74 × 0.06–0.1 mm in the female, and bears 9 longitudinal rows of 18–19 hooks each, of which the largest anterior are up to 60–72 μ long and

the smallest basal 27–36 μ long, all having a simple root shorter than the blade. The slender neck, up to 0.25 mm broad at the base and sharply delimited from the trunk, is very variable in length, being 1.1 mm long in the female when contracted, but up to twice as long when extended. The proboscis sheath, 0.43–0.7 × 0.07–0.1 mm in the male and 1.38–2.3 × 0.15–0.22 mm in the female, has a double wall, the outer of which is up to 24 μ thick and consists of strong spiral muscular bundles. The elongate cephalic ganglion lies at the base of the proboscis sheath, from which the two retinacula arise. The finger-like lemnisci are 0.38–0.5 mm long by 0.06–0.12 mm broad in the male and 1.25–1.81 mm long by 0.14–0.25 mm broad in the female. The approximately cylindrical trunk is 1.87–2.8 × 0.32–0.52 mm in the male and 9.4–14 × 0.6–1.0 mm in gravid females.

The spherical to oval testes, 0.24–0.32 mm long, lie exactly or obliquely tandem in the middle third of the trunk. The elongate oval vesicula seminalis, up to 0.16 mm long, are on the dorsal side of the posterior ends of the cement ducts. The spherical to oval cement glands, 0.06–0.12 mm long, are closely massed together between the posterior testis and the Säfftigen's pouch, each having a slender duct. It is worth noting that the

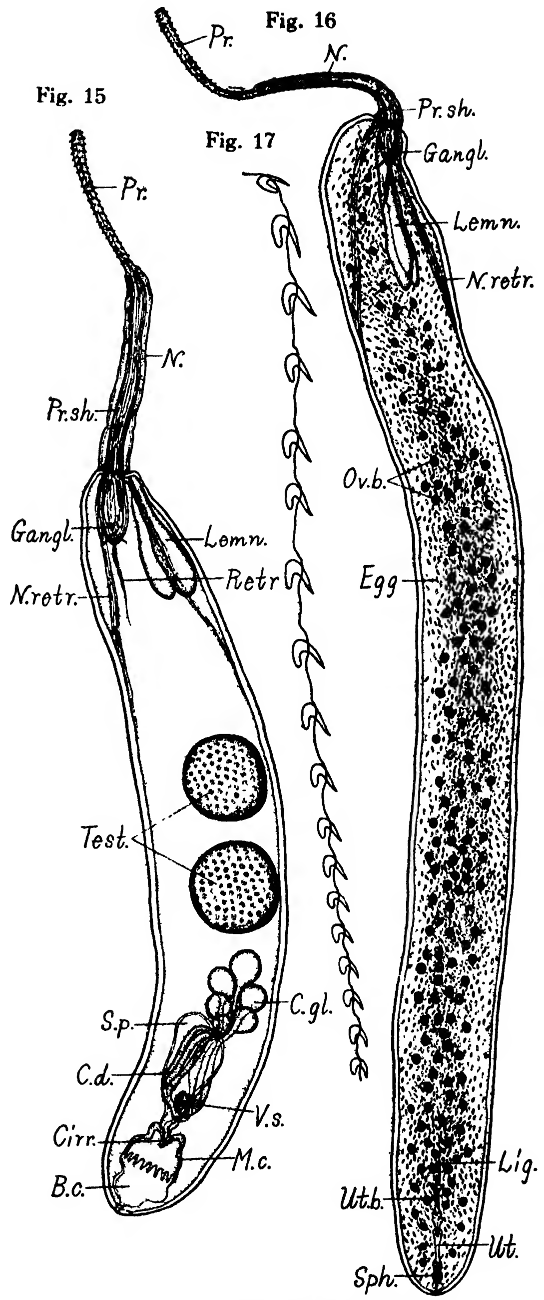

Fig. 15–17. *Tenuiproboscis misgurni.*
Fig. 15. ♂, 4.0 mm long.
Fig. 16. ♀, 17.2 mm long.
Fig. 17. Proboscis hooks.

glands vary from 4 to 6 in number, 3 on one side and 1–3 on the other. The Säfftigen's pouch, 0.4–0.5 mm long, has a transparent content. The muscular bursa cap has two anterior diverticula and numerous small digitiform rays.

There is a long-stalked uterine bell widely open in front. The relatively short uterus is up to 0.25–0.3 mm long. The vagina has an inconspicuous outer and a well defined inner sphincter, behind which is a large vaginal bulb of apparently vesicular structure. In the body cavity there are numerous oval to ellipsoidal ovarial balls along with eggs, of which the middle shell with polar prolongations is $51–63 \times 9–12\ \mu$. The elongate ellipsoidal embryo is $33–39 \times 6–8\ \mu$.

DISCUSSION. Except for the exceedingly long slender proboscis and neck, this genus bears a close affinity to *Acanthocephalus* Koelreuter, 1771. It may be defined as follows.

Tenuiproboscis n. g.

GENERIC DIAGNOSIS. Echinorhynchidae Cobbold, 1879. Proboscis nearly filiform; hooks shorter posteriorly, with simple rod-shaped roots. Neck very long, slender, unarmed. Trunk approximately cylindrical, fairly long in female, but short in male. Proboscis sheath slender, double-walled, with cephalic ganglion at base. Lemnisci digitiform, shorter than proboscis sheath, though extending beyond its posterior end. Testes in middle third of trunk. Vesicula seminalis at posterior ends of cement ducts. 4–6 (usually 6) spherical to oval cement glands closely massed together. Säfftigen's pouch elongate, transparent. Muscular bursa cap with two saccular anterior diverticula and numerous digitiform rays. Uterine bell with long stalk. Uterus relatively short. Outer vaginal sphincter inconspicuous, inner well defined, small. Ovarial balls small, numerous, free in trunk cavity. Middle egg shell with polar prolongations. Parasitic in freshwater fishes.

Genotype. *Tenuiproboscis misgurni.*

Tenuiproboscis misgurni n. sp.

SPECIFIC DIAGNOSIS. *Tenuiproboscis;* with generic characters. Proboscis $0.66–0.75 \times 0.06–0.075$ mm in male, $1.6–1.74 \times 0.06–0.1$ mm in female, with 9 longitudinal rows of 18–19 hooks each; largest hooks 60–72 μ long, smallest basal 27–36 μ long. Neck up to 2.25 mm long. Trunk $1.87–2.8 \times 0.32–0.52$ mm in male, $9.4–14 \times 0.6–1.0$ mm in female. Proboscis sheath $0.43–0.7 \times 0.07–0.1$ mm in male, $1.38–2.3 \times 0.15–0.22$ mm in female. Lemnisci 0.38–0.5 mm long in male, 1.25–1.81 mm long in female. Testes spherical to oval, 0.24–0.32 mm long. Middle egg shell with polar prolongations $51–63 \times 9–12\ \mu$. Embryo $33–39 \times 6–8\ \mu$.

Habitat. Stomach of *Misgurnus fossilis* (Linné).
Locality. Unknown.
Date. June 24, 1932.
Type and paratypes in my collection.

CENTRORHYNCHIDAE Van Cleave, 1916

11. *Centrorhynchus elongatus* n. sp.

DESCRIPTION. A number of specimens were found in the small intestine of *Otus bakkamoena semitorques* Temm. et Schl. and *Asio otus otus* (Linné)

from Sizuoka Prefecture. They are slender, 13–33 mm long or longer and very slightly broadened at the anterior part of the trunk, where the testes are situated. The hypodermis contains numerous scattered nuclei with a very irregular outline and chromatin granules of varying size. The short cylindrical proboscis is 0.33–0.37 mm long by 0.21–0.28 mm broad in the male and 0.42–0.56 mm long by 0.28–0.36 mm broad in the female; sometimes it may be distinctly constricted off from the neck, but the two regions are usually almost indistinguishable from each other unless the origin of the proboscis sheath is ascertained. The proboscis hooks are arranged in 25–33 longitudinal rows extending backwards over the neck to near its base; in the proboscis proper each row consists of 9–10 hooks, but in the neck of 5–8. Near the apex of the proboscis, the hooks are strongly recurved and heavy with a simple root 48–63 μ in maximum length, but posteriorly they become slender with the reduction of their roots and are 33–42 μ long at the base. The neck, a little broader than the proboscis, is up to 0.3 mm long in the male and 0.54 mm long in the female. The double-walled proboscis sheath is 0.7–1.2 mm long in the male but may attain a length of 1.5 mm in the female. The two retinacula arise further backward than the middle of the proboscis sheath (0.44–0.5 mm in front of the posterior end of the proboscis sheath in male and 0.5–0.63 mm in female). The elongate lemnisci reach to near the anterior testis, but may occa-

Fig. 19

Fig. 18

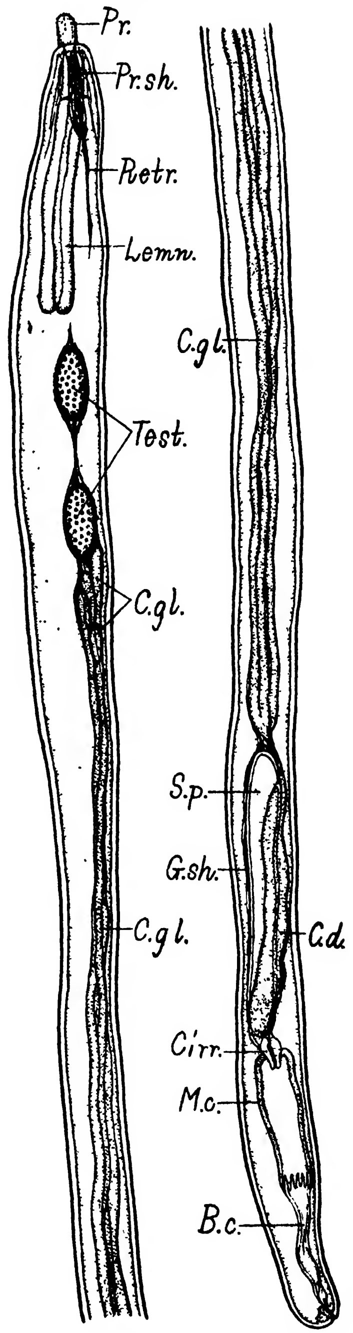

Fig. 18–19. *Centrorhynchus elongatus.*
Fig. 18. ♂, 33.0 mm long.
Fig. 19. Proboscis hooks.

sionally extend farther backwards.

The oval to elliptical testes, 0.56–1.17×0.3–0.7 mm, lie directly tandem or a little separated from each other in the enlarged anterior third of the trunk. The ductus ejaculatorius has at its distal end two sphincters, of which the posterior (0.15–0.19 mm broad) is much larger. The four exceedingly long cement glands beginning just behind the posterior testis at unequal levels, send out posteriorly two wide ducts which are constricted at the anterior end of the Säfftigen's pouch and then proceed along the sides of the organ. The elongate Säfftigen's pouch is 1.7–4.8 mm long by 0.2–0.4 mm broad. The muscular bursa cap has 14 digitiform posterior rays 0.3–0.5 mm long, but no anterior diverticula. There is no uterine bell. The suspender of the uterus arising from the body wall consists of a thin inner longitudinal and a thick outer circular muscle layer, both continuing directly into the wall of the uterus. The uterus with a relatively large aperture is up to 0.4–0.43 mm long by 0.05–0.075 mm wide. The vaginal sphincters form a double bulb, of which the anterior is 0.1–0.11 mm broad and the posterior 0.06–0.1 mm broad.

The outer egg shell is 72–84×27–30 μ, the middle 57–63×15–18 μ, the inner 45–51×12–15 μ, and the embryo 37–42×11–12 μ.

DISCUSSION. From otidiform birds there have been recorded three species[1] of *Echinorhynchus* s. l. and *Centrorhynchus embae* Kholodkowsky et Kostylew, 1916, but since the old ones are too meagerly described for comparison and the Russian species is known to me only by name, I would provisionally regard mine as new.

Centrorhynchus elongatus n. sp.

SPECIFIC DIAGNOSIS. *Centrorhynchus* Lühe, 1911; with generic characters emended[2]. Body 33 mm long or longer, very slightly enlarged at anterior third of trunk. Proboscis 0.33–0.56×0.21–0.36 mm. Proboscis hooks 33–63 μ long, in 25–33 longitudinal rows of 14–18 each, extending backwards over neck to near its base. Neck 0.3–0.54 mm long, a little broader than proboscis. Proboscis sheath 0.7–1.5 mm long. Retinacula arising 0.44–0.63 mm in front of posterior end of proboscis sheath. Lemnisci reaching to near anterior testis or a little farther backwards. Testes 0.56–1.17×0.3–0.7 mm, directly tandem or a little separated from each other, in anterior third of trunk. Muscular bursa cap with 14 digitiform rays 0.3–0.5 mm long. Outer egg shell 72–84×27–30 μ, middle 57–63×15–18 μ, inner 45–51×12–15 μ. Embryo 37–42×11–12 μ.

Habitat. Small intestine of *Otus bakkamoena semitorques* Temm. et Schl. (type host) and *Asio otus otus* (Linné).

Locality and date. Sizuoka Prefecture; Jan. 13, 1932.

Type and paratypes in my collection.

12. *Centrorhynchus microrchis* Fukui, 1929

I found this worm on January 23, 1933, in the intestine of *Milvus lineatus lineatus* (Gray) from Siga Prefecture and on December 23, 1933, in the intestine of *Nycticorax nycticorax* shot at the Momoyama Imperial Mausoleum.

[1] *Otidis* Schrank, 1788; *otidis-houbarae* Dies., 1851; *tardae* Rud., 1809.

[2] Lühe's terminology of proboscis should be emended, because the level where the proboscis sheath arises should be regarded as the posterior end of the proboscis.

The largest, somewhat contracted specimen from the former host is 32 mm long by 1.3 mm broad. The cylindrical or conical proboscis is 0.56–0.73 mm long by 0.26–0.35 mm broad and more or less constricted off from the neck, which measures 0.38–0.56 × 0.37–0.45 mm. The proboscis hooks are in 37–42 longitudinal rows of 25–27 each and extend backward to near the base of the neck; the largest anterior ones with a long simple root are 33–48 μ long in the male and 36–57 μ long in the female, while the slender basal are 36–42 μ and 45–48 μ long respectively. As stated by Fukui the hook rows are usually less numerous in the male than in the female. The proboscis sheath is 1.2–1.8 mm long. The retinacula arise 0.45–0.6 mm in front of the posterior end of the proboscis sheath. The elongate club-shaped lemnisci extend farther backwards than the proboscis sheath and may well reach to near the anterior testis.

The oval testes lying directly tandem or partly overlapping each other at the middle of the swollen anterior third of the trunk, are 0.9–1.16 mm long by 0.58–0.62 mm broad, the anterior being a little larger.

The outer egg shell with numerous longitudinal filaments attached to its inner surface is 54–66 × 24–30 μ, the thick middle 48–57 × 21–24 μ, and the inner 39–45 × 16–20 μ. The embryo measures 33–42 × 12–18 μ.

13. *Centrorhynchus corvi* Fukui, 1929

One male (14.3 mm long) and one female (19 mm long) adults were obtained from the small intestine of *Corvus corone interpositas* Laubmann from the vicinity of Kyoto.

MALE. The subglobular proboscis, 0.4 × 0.38 mm and slightly constricted off from the neck, has 36 longitudinal rows of hooks continuing over the neck to beyond its middle, each row consisting of about 10 hooks on the proboscis and of 3–4 on the neck; the largest, strongly recurved hooks behind the apex of the proboscis are 42 μ long and have a simple rod-shaped root longer than the blade; the hooks with reduced roots on the neck, which is 0.37 mm long by 0.5 mm broad at the base, are about 36 μ long and lie more widely apart from one another than on the proboscis. The double-walled proboscis sheath is 1.15 mm long by 0.35 mm broad. The elliptical ganglion, about 0.15 mm long, lies at about the middle of the proboscis sheath. The elongate club-shaped lemnisci are about 2.8 mm long. The ellipsoidal testes are 1.3 mm long by 0.56–0.63 mm broad and lie in the second fourth of the body, as described by Fukui. The ductus ejaculatorius has two sphincters, the anterior being 0.11 mm broad and the posterior 0.15 mm broad. The four cement glands send out posteriorly two very wide ducts constricted at the anterior end of the Säfftigen's pouch 2.08 mm long. The muscular bursa cap has a number of digitiform rays about 0.31 mm long. The lacunar system of the trunk is reticular.

FEMALE. The proboscis is about 0.5 mm long by 0.32 mm broad. The proboscis hooks, whose number could not be counted with certainty, are up

Fig. 20. Egg of *Centrorhynchus corvi.*

to 51 μ long anteriorly and 42 μ long in the last row at about the middle of the neck. The proboscis sheath is just as long as in the male. The neck is about 0.38 mm long. The outer egg shell with longitudinal filaments on its inner surface is 64–69 × 24–27 μ, the thick middle 51–57 × 18–21 μ, and the inner 42–48 × 13–17 μ. The embryo is 36–42 × 11–15 μ.

On the basis of the above description I regard this species as a typical *Centrorhynchus* and therefore cannot agree with Witenberg in separating it as type of *Travassosina* Witenberg, 1932. But before determining its specific validity, it is very desirable, if possible, to compare it with other species already recorded from *Corvus*, such as *Echinorhynchus cornicis* Rud., 1819, *E. pigmentatus* Fuhrmann in Wolffh., 1900, *E. rostratus* Fuhrmann in Wolffh., 1900, *E. robustus* Datta, 1928, *Centrorhynchus bipartitus* and *C. leguminosus* Soloviev, 1912.

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14. *Porrorchis elongatus* Fukui, 1929

One male and three female adults were found in the small intestine of *Gorsakius goisagi* (Temminck) shot near Kyoto. The following note is to provide supplementary data to Fukui's description.

The male is 35 mm long and 2.0 mm broad at the enlarged testicular zone, while the females are up to 63 mm long by 2.5 mm broad. The proboscis, up to 0.75 × 0.54 mm, bears 30–34 longitudinal rows of 12–13 hooks each, of which the anterior ones, up to 96 μ long, are strongly recurved and have rod-shaped roots, while the posterior ones, up to 93 μ long, are arcuate and have short, forwardly directed roots. The conical neck is 0.25–0.37 mm long. The double-walled proboscis sheath is 1.65–2.1 mm long by 0.5–0.6 mm broad, with the cephalic ganglion behind its middle. The two lemnisci are 3.7–5.7 mm long. The elliptical testes are 1.1–1.5 × 0.5–0.56 mm. The Säfftigen's pouch is 2.5 mm long. The four cylindrical cement glands send out at the anterior end of the Säfftigen's pouch two very wide ducts. The muscular bursa cap has numerous posterior rays but no anterior diverticula as in *Centrorhynchus*. The uterine bell is 0.35 × 0.27 mm, the uterus 2.0 mm long and the anterior and posterior vaginal sphincters are 1.62 mm broad in a female 56 mm long. The outer egg shell with filaments inside is 54–66 × 25–33 μ, the thick middle 44–57 × 22–27 μ, and the inner 37–48 × 15–21 μ. The embryo is 36–45 × 12–18 μ.

This genus is very closely related to *Centrorhynchus* Lühe, 1911, as sug-

gested by Fukui, but differs chiefly in the neck being entirely hookless. I refer it to Centrorhynchinae.

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Polymorphidae Meyer, 1931, e. p.

15. *Polymorphus capellae* n. sp.

Description. A number of adults and three larvae of this species were found in the small and large intestines of *Capella solitaria* (Hodgson) from Nagano Prefecture. The males are up to 25 mm long and the females 30 mm long, with a maximum breadth of about 1.0 mm. The proboscis, more or less swollen behind its middle, is 0.36–0.65 mm long in the male and 0.7–0.8 mm long in the female, with a nearly equal breadth of 0.14–0.22 mm for both sexes. The proboscis hooks in 17–18 longitudinal rows of 14–16 each are heavy, strongly recurved, up to 54 μ long and have a simple rod-shaped root in the greater anterior part, but posteriorly they are rather slender, up to 45 μ long and almost completely rootless. The cone-shaped unarmed neck is 0.33–0.5 mm long and 0.2–0.38 mm broad at the base. The cylindrical trunk is beset at its anterior end for a distance of 1.5–2.6 mm with over 40 longitudinal rows of small spines 21–24 μ long and ensheathed for the greater basal-part by cuticular folds. The well developed circular muscles of the trunk appear as very beautiful annulations under low magnification. The distinctly double-walled proboscis sheath is 0.9–1.31 × 0.16–0.23 mm in the male and 1.2–1.5 × 0.18–0.23 mm in the female. The elongate cephalic ganglion, 0.18–0.2 × 0.03 mm, lies at about the middle of the proboscis sheath or a little behind it. The retinaculum leaves the proboscis sheath about half as far from its posterior end as from its anterior. Inside the proboscis there are two elongate saccular vesicles of different sizes (0.17–0.38 × 0.038–0.08 mm), which

Fig. 21

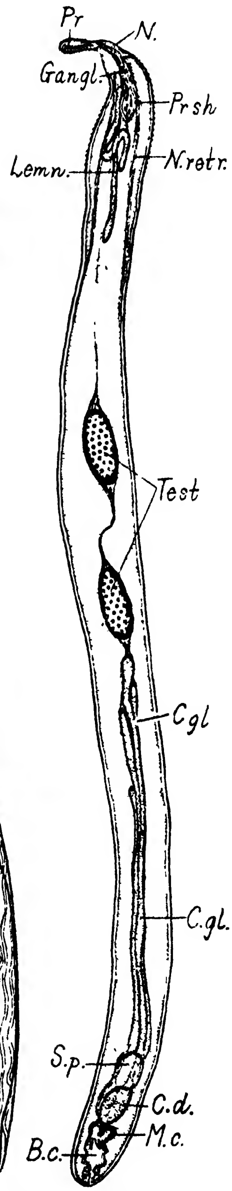

Fig. 22

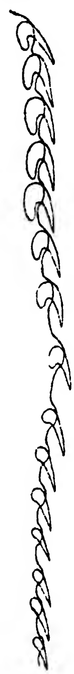

Fig. 23

Fig. 21–23. *Polymorphus capellae*.
Fig. 21. ♂, 17.0 mm long.
Fig. 22. Proboscis hooks.
Fig. 23. Egg, 100 × 24 μ.

arise from the inner surface of the proboscis at its posterior end and are usually directed forwards, pushing aside the retractor of the proboscis; they have a very thin membranous wall and contains homogeneous or finely granular substance of unknown nature. I propose to call them "proboscis vesicle". In a female 30 mm long, the long slender, sometimes coiled lemnisci extend 2.25 mm farther backward than the proboscis sheath.

The ellipsoidal testes, 0.8–1.38 × 0.26–0.47 mm, lie one 0.75–1.62 mm behind the other, the posterior at the middle of the trunk or a little in front of it. The four slender cement glands beginning at unequal levels behind the posterior testis send out at the anterior end of the Säfftigen's pouch two ducts, which are enormously enlarged posteriorly. The muscular bursa cap has a pair of anterior diverticula and numerous more or less pointed rays.

The uterine bell is 0.2–0.3 × 0.11–0.16 mm. The uterus is 0.43–0.56 mm long. The anterior vaginal sphincter is 66–81 μ broad and the posterior 72–84 μ broad. The ellipsoidal outer egg shell with filaments attached to its inner surface is 90–105 × 21–27 μ, the thick middle with conspicuous polar prolongations 88–100 × 16–21 μ, and the thin inner 49–57 × 12–15 μ. The ellipsoidal embryo is 30–47 × 11–14 μ.

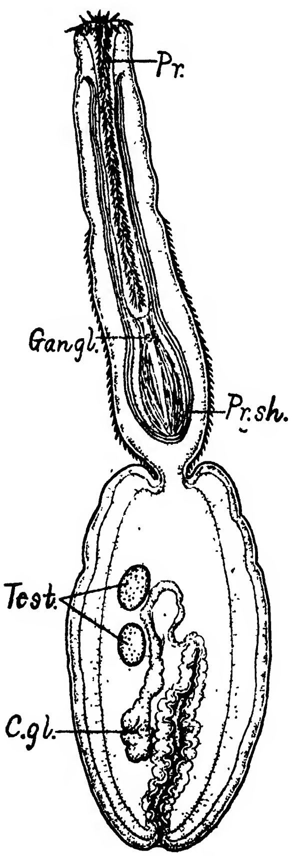

Fig. 24. Larva of *Polymorphus capellae*, 1.94 mm long.

The larvae have a very characteristic shape as represented by Lühe for *Polymorphus minutus* (fig. 32). The proboscis, 0.67–0.8 mm long, is almost entirely invaginated into the sheath. The heavy anterior hooks with a strong root are 48–51 μ long and the rootless basal ones about 45 μ long; their arrangement could not be made out owing to the invagination of the proboscis. The proboscis sheath, 0.87–1.0 mm long, is as broad as 0.15–0.2 mm at the posterior end. The cephalic ganglion and the origin of each retinaculum are pushed by the invaginated proboscis farther backwards than in the adult. The neck, 0.38–0.4 mm long, is clearly marked off from the next broader part which is 0.6–0.75 mm long by 0.2–0.3 mm broad and closely beset with ensheathed spines 21–24 μ long. The elliptical posterior half of the body, 0.88–1.0 × 0.44–0.5 mm, contains genital anlagen and a long invagination of the posterior end reaching forwards beyond its middle.

Discussion. This species, the first of *Polymorphus* that has been described from Charadriiformes, is characterized by the long slender body.

Polymorphus capellae n. sp.

SPECIFIC DIAGNOSIS. *Polymorphus* Lühe, 1911; with generic characters. Body cylindrical, up to 25 mm long in male and 30 mm long by 1.0 mm broad in female. Proboscis more or less swollen behind its middle, 0.36–0.8×0.14–0.22 mm. Proboscis hooks in 17–18 longitudinal rows of 14–16 each; anterior ones strongly recurved, heavy, up to 54 μ long, with rod-shaped root; posterior ones shorter, rootless. Neck cone-shaped, 0.33–0.5×0.2–0.38 mm. Trunk spines 21-24 μ long, in over 40 longitudinal rows. Proboscis sheath 0.9–1.5×0.16–0.23 mm. Cephalic ganglion at about middle of proboscis sheath or a little further behind. Proboscis vesicle present. Testes elliptical, 0.8–1.38×0.26–0.47 mm, tandem; posterior one at middle of trunk or a little further in front. Uterine bell 0.2–0.3×0.11–0.16 mm. Uterus 0.43–0.56 mm long. Anterior vaginal sphincter 66–81 μ broad, posterior 72–84 μ broad. Outer egg shell with numerous longitudinal filaments attached to its inner surface 90-105×21–27 μ; thick middle with conspicuous polar prolongations 88–100×16–21 μ; inner 49–57×12–15 μ. Embryo 30-47×11–14 μ.

Habitat. Intestine of *Capella solitaria*.

Locality and date. Nagano Prefecture; March 6, 1933.

Type and paratypes in my collection.

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16. *Southwellina hispida* (Van Cleave, 1925) Witenberg, 1932

Syn. *Arhythmorhynchus hispidus* Van Cleave, 1925
A. fuscus Harada, 1929

The larva of this species was described by Van Cleave in 1925 and the adult by Fukui in 1929. In this year Harada reported the same species under the name of *Arhythmorhynchus fuscus*, apparently unaware of Van Cleave's paper. These worms are, however, not to be included in *Arhythmorhynchus* Lühe, 1911, because they differ fundamentally in the proboscis hooks, egg shells, etc.

LARVA. I found the encysted larvae on October 27–28, 1929, in the mesenteries of *Rhinogobius* sp., *Cyprinus carassius* and *Elaphe quadrivirgata* at Namerikawa, Toyama Prefecture. The body is approximately spindle-shaped and 3.5–4.3 mm long in the specimens stretched out under a cover slip. The proboscis, slightly enlarged at the middle or just behind it, is 0.72–0.8 mm long by 0.25–0.28 mm broad and bears 20 longitudinal rows of 13–15 hooks each, of which the heaviest on the swollen part are 63–66 μ long and have a simple rod-shaped root, while the basal spines are about 50–54 μ long. The posteriorly broadened neck is 0.25–0.4 mm long. The lemnisci are a little longer than the proboscis sheath, which is distinctly double-walled. The ganglion and retinacula could not be made out with certainty. The anterior 0.5–0.65 mm of the trunk is armed with numerous sharp spines about 18 μ long.

ADULT. Large numbers of adults were obtained from the small intestine of *Nycticorax nycticorax nycticorax* shot at the Momoyama Imperial Mausoleum. The male is up to 13 mm long and the female 17 mm long. The fusiform proboscis, 0.7–0.8 mm long by 0.27–0.3 mm broad, has 19–21 longitudinal rows of 13–15 hooks each; the heaviest hooks with long simple roots on the swollen part are up to 66 μ long and the basal spines a little shorter. The cone-shaped

neck is 0.32–0.5 mm long. The minute spines on the anterior part of the trunk are 18 μ long and more sparse than in the larva. The cephalic ganglion and the transverse retinacula lie behind the middle of the proboscis sheath, which measures $1.25–2.5 \times 0.32–0.4$ mm. The elongate saccular lemnisci extend 0.65–1.8 mm farther backwards than the proboscis sheath, and may stop short of the anterior testis or reach to the level of the front end of the posterior testis. The globular to oval testes, $0.85–1.1 \times 0.62–0.85$ mm, lie exactly or obliquely tandem in the enlarged anterior third of the body. The four cylindrical cement glands lie close together behind the posterior testis.

The ellipsoidal ovarial balls of varying size lie free in the body cavity. The elliptical outer egg shell is $96–123 \times 30–40$ μ, the middle with polar prolongations $75–102 \times 24–31$ μ, and the inner $57–72 \times 21–28$ μ. The embryo is $48–66 \times 16–19$ μ.

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17. *Corynosoma* sp.

Two immature females were obtained from the small intestine of *Delphinus longirostris* Cuvier at Kuki, Mie Prefecture. Unfortunately the larger specimen was injured at the time the host was opened, but the smaller is intact and measures 14 mm long by 0.66 mm broad. The elliptical proboscis, $0.68–0.8 \times 0.37–0.41$ mm, is covered by 18 longitudinal rows of about 9 hooks each; the anterior hooks are 75–80 μ long, the heaviest middle with a simple rod-shaped root 99–105 μ long, and the spinous posterior 84 μ long. The neck is 0.63–0.75 mm long. The anterior part of the trunk is closely beset with spines ensheathed in cuticular shields and forming two groups separated by an interval of 0.13–0.15 mm. The anterior group beginning at the extreme anterior end of the trunk extends backwards for a distance of 0.43–47 mm, and the posterior, 0.25–0.38 mm long, encircles the prominent bulla, which is 0.88–1.0 mm broad and lies at the level of the posterior part of the proboscis sheath. It is interesting to note that the spines of the anterior group are up to 36 μ long and somewhat enlarged near the base, while those of the posterior group are very broad, bluntly pointed and up to 60 μ long, with numerous longitudinal internal striations which are more conspicuous than in the former. The proboscis sheath, $1.7–1.84 \times 0.35–0.38$ mm, has a very thick internal wall. The lemnisci extend backwards to the level of the posterior end of the proboscis sheath or farther posteriorly. The two retractors of the proboscis sheath are about 1.8 mm long. The vagina has a double sphincter-like outer bulb enclosed in a muscular mantle and an inner muscle sheath of diagonal fibers.

The specific determination of this worm is reserved until corresponding adults are obtained.

RHADINORHYNCHIDAE Travassos, 1923

18. *Rhadinorhynchus katsuwonis* Harada, 1928

The following note based on my material from the common Japanese bonito, *Euthynnus pelamys* (Linné), is supplementary to Harada's description.

MALE. The proboscis, 1.6–2.0 × 0.16–0.23 mm, bears 20–21 longitudinal rows of 28–39 hooks each, of which the largest anterior are 69–72 μ long and the basal 80 μ long. The neck is 0.32–0.35 mm long. The trunk is 10–17 × 0.62–0.65 mm; its spines, up to 66 μ long and ensheathed in cuticular folds, form two separate groups on the ventral side; the anterior group at the front end of the trunk consists of 17–20 spines in 3 indefinite transverse rows, and the posterior, beginning 0.65–0.75 mm behind the anterior and reaching to the posterior end of the proboscis sheath, consists of about 18 spines in regular transverse rows in front but rather irregular behind; in one specimen there are in the posterior group only 11 spines in three transverse rows. The proboscis sheath is 3.5–4.8 × 0.27–0.33 mm. The lemnisci are just as long as the proboscis sheath or a little shorter. The ellipsoidal testes, 0.75–1.1 × 0.4–0.5 mm, lie directly tandem in the middle third of the trunk. The four cylindrical cement glands beginning immediately behind the posterior testis are 3.0–5.6 mm long and discharge directly into the ejaculatory duct. The elongate Säfftigen's pouch is 1.5–2.0 mm long. The muscular bursa cap has on its inner surface numerous papillae, as observed by Hamann in *Echinorhynchus clavula*; its saccular anterior diverticula have no papillae. The number of digitiform rays could not be counted.

FEMALE. The proboscis is 1.63–2.5 × 0.17–0.28 mm, with 18–21 longitudinal rows of 27–40 hooks each, the largest anterior hooks being 78–90 μ long and the basal ones 80–108 μ. The neck is up to 0.44 mm long and 0.4 mm broad at the base. The trunk is 28 × 1.0 mm in the largest specimen at my disposal. The trunk spines, up to 90 μ long, are arranged on the ventral side more irregularly than in the male and usually not separated into two distinct groups, the total number varying from 43 to 97. The proboscis sheath is 3.6–5.8 mm in length and 0.38 mm in maximum breadth. The lemnisci are similar to those of the male. The dorsoterminally opening vagina has a large muscular bulb, the "outer sphincter" of Leuckart, measuring 0.13–0.2 mm in diameter. In fully matured eggs containing exceedingly fine granules between the outer and the middle shell, the outer shell is 78–87 × 25–28 μ, the thick middle with polar prolongations 63–74 × 16–21 μ, and the inner 39–42 × 12 μ. The embryo is 31–39 × 9–11 μ. The eggs without polar prolongations of the middle shell, observed by Harada in the uterus, are obviously immature ones.

There is no sound reason for separating this species from *Rhadinorhynchus* Lühe, 1911, as type of *Nipporhynchus* Chandler, 1934.

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Hamann, O. Die Nemathelminthen, I. Heft, 1891, p. 81.

Harada, I. A new species of Acanthocephala from the Japanese bonito, *Euthynnus vagans*. Jap. Jour. Zool., Vol. 2, No. 1, 1928, p. 1–4.

Leuckart, R. Die menschlichen Parasiten und die von ihnen herrührenden Krankheiten, II. Bd., 1876, p. 800.

Arhythmacanthidae n. fam.

19. *Arhythmacanthus fusiformis* n. g. n. sp.

Description. Several male adults of this species were found on April 8, 1927, in the small intestine of *Spheroides* species common on the Pacific coast of Wakayama and Mie Prefectures. Unfortunately gravid females could not be obtained, so that the following description is based on males only.

The pear- to spindle-shaped body is 5–6 mm long and 2.0–2.8 mm in maximum breadth at about the middle. The rounded proboscis, 0.34–0.43 mm long, has three different sets of hooks. At the apex there are 18 hooks 45–63 μ long. The largest subapical hooks in two alternate rows of seven each, are 0.188–0.21 mm long, strongly recurved at the base, and have a long slender blade and a simple, distally attenuated root less than half as long as the blade. The small basal hooks, 24–69 μ long, form 14 longitudinal rows of 2–3 each (usually 3). The unarmed neck, 0.18–0.22 mm long, is distinctly constricted off from the trunk but almost indistinguishable from the proboscis by its outer surface. The trunk with a very thick hypodermis containing numerous scattered nuclei, is covered on its anterior half by minute, closely set spines whose long

Fig. 52

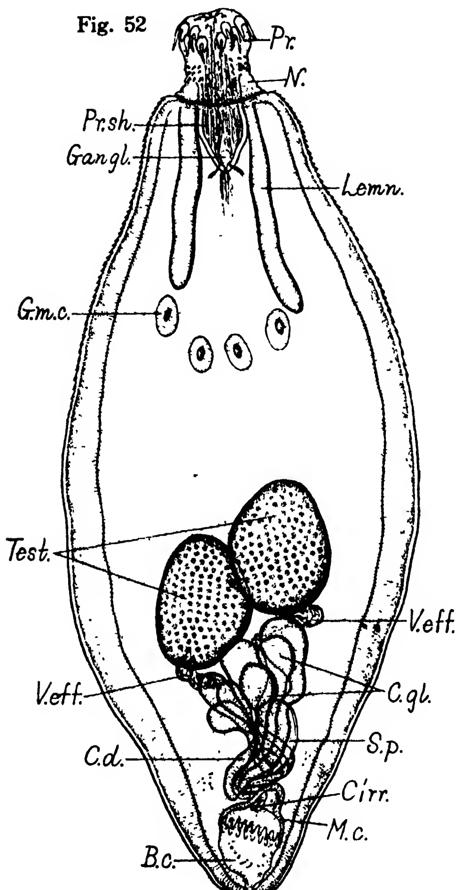

Fig. 26

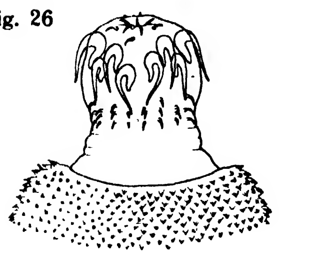

Fig. 25–26. *Arhythmacanthus fusiformis*.
Fig. 25. ♂, 5.7 mm long.
Fig. 26. Proboscis magnified.

simple roots are deeply imbedded in the center of scale-like cuticular folds; posteriorly these spines become gradually sparse. At the posterior end of the anterior third of the trunk there are, as in *Acanthocephaloides rhinoplagusiae*, four giant muscle cells with elliptical nuclei 0.11–0.12 mm long by 0.05–0.06 mm broad. The double-walled proboscis sheath is 0.6–0.72 mm long by 0.25–0.3 mm broad. The cephalic ganglion lies at the base of the proboscis sheath, from which the two short retinacula arise. There are two, occasionally four, finger-like lemnisci varying in length from 0.5 mm to 1.6 mm.

The ovoid, postequatorial testes, 0.7–0.88 × 0.5–0.62 mm, lie contiguous one obliquely behind the other. The very wide vasa efferentia are conspicuously twisted. The oval vesicula seminalis, up to 0.25 mm broad, lies on the dorsal side of the distal ends of the cement ducts. The 6–8 pyriform cement glands are closely massed together behind the testes. The Säfftigen's pouch is elongate club-shaped. The muscular bursa cap has two saccular diverticula and 20 digitiform rays 0.05–0.06 mm long. The genital pore is exactly terminal.

DISCUSSION. This species has a closer affinity to *Heterosentis* Van Cleave, 1931, than to any of the other piscine genera possessing armed trunk, such as *Rhadinorhynchus* Lühe, 1911, *Quadrigyrus* Van Cleave, 1920, *Tegorhynchus* Van Cleave, 1921, *Telosentis* Van Cleave, 1923, *Serrasentis* Van Cleave, 1925, *Polyacanthorhynchus* Travassos, 1926, *Acanthogyrus* Thapar, 1927, *Cleaveius* Subramanian, 1927, *Pallisentis* Van Cleave, 1928, *Neosentis* Van Cleave, 1928, *Aspersentis* Van Cleave, 1929, *Acanthosentis* Verma et Datta, 1929. It differs however, from *Heterosentis heteracanthus* (von Linstow, 1896) of Van Cleave or of Meyer chiefly in body shape, proboscis hooks and body spines.

The specific diagnosis is reserved until adult females are secured.

Arhythmacanthus n. g.

GENERIC DIAGNOSIS. Arhythmacanthidae; with family characters (v. i.). Proboscis short, with three different types of hooks. Neck short, unarmed. Trunk fusiform, with very thick hypodermis and four giant muscle cells on its inner surface at level of posterior ends of lemnisci; anterior half closely beset with spines ensheathed in scale-like cuticular folds. Proboscis sheath double-walled, with cephalic ganglion at base. Lemnisci two, occasionally four, digitiform, longer than proboscis sheath. Testes oval, contiguous, obliquely tandem, postequatorial. Vasa efferentia wide, twisted. 6–8 pyriform cement glands massed together behind testes. Säfftigen's pouch elongate. Muscular bursa cap with two saccular anterior diverticula and numerous digitiform rays. Parasitic in marine fishes.

Genotype. *Arhythmacanthus fusiformis*.

As is evident from the diagnosis, this genus belongs neither to Rhadinorhynchidae Travassos, 1923[1], nor to Quadrigyridae Van Cleave, 1920[2]. I prefer to create a new family, Arhythmacanthidae, for this genus and *Heterosentis* Van Cleave, 1931.

1) Body and proboscis long; latter with numerous, almost uniform hooks in longitudinal rows; cephalic ganglion far in front of base of proboscis sheath; cement glands elongate, cylindrical.

2) Proboscis sheath single-walled; subcuticular nuclei of two types (elliptical and branched); cement gland a long compact mass in type species of *Quadrigyrus*.

Fig. 27

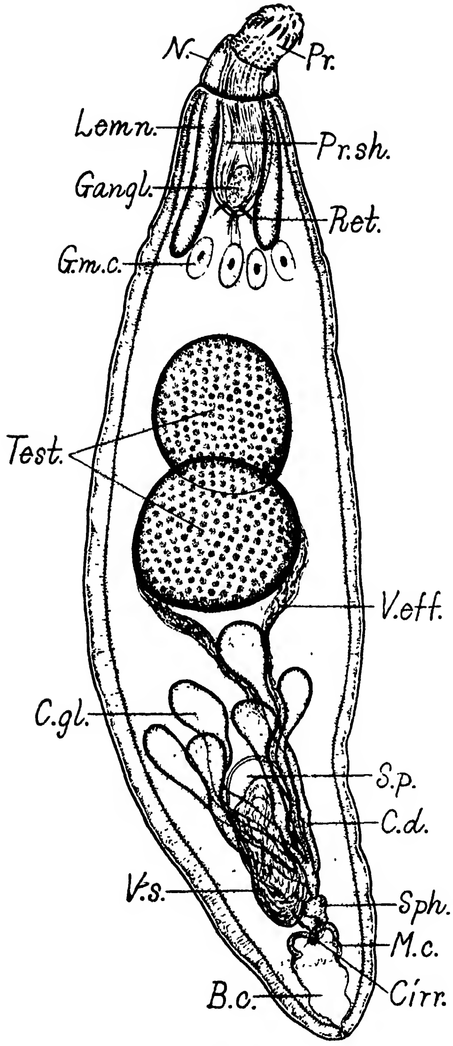

Fig. 28

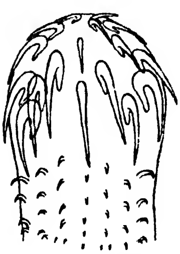

Fig. 27–28. *Heterosentis plotosi.*
Fig. 27. ♂, 2.47 mm long.
Fig. 28. Proboscis magnified.

ARHYTHMACANTHIDAE n. fam.

FAMILY DIAGNOSIS. Small to medium-sized Acanthocephala. Proboscis with different types of hooks. Neck short. Trunk with thick hypodermis containing numerous scattered nuclei, covered by spines on its anterior region. Proboscis sheath double-walled, with cephalic ganglion at base. Testes usually contiguous. 6–8 compact cement glands. Muscular bursa cap with two anterior diverticula and numerous digitiform rays. Adults parasitic in marine fishes. Including *Arhythmacanthus* n. g. and *Heterosentis* Van Cleave, 1931.

20. *Heterosentis plotosi* n. sp.

DESCRIPTION. A single adult male was found on July 25, 1926, in the small intestine of *Plotosus anguillaris* Lacépède from the Pacific coast of Wakayama Prefecture.

The short proboscis, 0.18×0.125 mm, bears two kinds of hooks; the anterior larger hooks in 6 spiral rows of 5 each, 36–72 μ long and longer posteriorly, have a long slender blade strongly recurved at the base and a simple posteriorly attenuated root; of the posterior ones in 14 longitudinal rows of 3–4 each, the first is about 18 μ long and the rest become gradually shorter posteriorly, the last ones, 9 μ long, being paired in each row. The unarmed neck is 0.11 mm long. The slightly fusiform trunk, 2.18 mm long by 0.57 mm broad at the middle, is armed anteriorly with exceedingly fine spines not ensheathed in cuticular folds. On the inner surface there is a transverse row of four giant muscle cells just behind the lemnisci. The double-walled proboscis sheath is 0.38 mm long by 0.12 mm broad. The cephalic ganglion lies at the base of the proboscis sheath. The two elongate lemnisci are about 0.4 mm long.

The ovoid testes, 0.37–0.4 mm long by 0.33–0.35 mm broad, lie directly tandem at the middle of the whole body. Each vas efferens is very wide but not twisted. The oval vesicula seminalis, 0.11 mm broad, lies at the posterior ends of the cement ducts. There are six pyriform cement glands immediately behind the posterior testis. The proximal end of the ductus ejaculatorius forms a sphincter-like bulb 54 μ broad. The elongate Säfftigen's pouch is about 0.45 mm long. The muscular bursa cap has two saccular anterior diverticula and small digitiform rays, whose number could not be made out. The globular bursa, 0.088 mm in diameter, has a muscular wall 12 μ thick. The genital pore is terminal.

DISCUSSION. This species has a number of important generic characters in common with *Heterosentis heteracanthus* (von Linst., 1896) Van Cleave, 1931, but differs from it distinctly in the number and arrangement of proboscis hooks, in the size of body spines, etc. The specific diagnosis is reserved until adult females are obtained.

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NEOECHINORHYNCHIDAE Hamann, 1892

21. *Neoechinorhynchus agilis* (Rud., 1819)

In 1895 Hamann described this species in detail, but he was mistaken in thinking that the cement glands were six. Van Cleave has corroborated Bieler's statement that the gland is a syncytium containing eight giant nuclei.

On the basis of my material obtained from *Mugil cephalus* from the Inland Sea and the Pacific coast of Mie Prefecture, I venture to give here a brief account of the worm and to correct Hamann's errors in regard to the cement gland. The body is 7.0–22.0 mm long by 0.6–1.0 mm broad. The conspicuous circular lacunae of the hypodermis are disposed at close regular intervals, as pointed out by Hamann. The short stout proboscis, 0.13–0.15 mm long, bears three circles of six hooks each, measuring 84–140 μ, 39–81 μ and 36–60 μ in each circle. The structure of the proboscis conforms well to Hamann's description. There is a conspicuous muscular ring just behind the origin of the proboscis sheath. The latter, 0.55–0.7 mm long by 0.13–0.24 mm broad, has a very thick wall of circular muscle fibers and contains at the base a fairly large mass of ganglion cells enclosed in the retractor muscle sheath of the proboscis. The short retinaculum and the long retractor of the proboscis sheath arise on either side of the proboscis sheath near its posterior end. The lemnisci are very long and reach backwards to the posterior end of the ante-

rior testis. The elongate oval testes, 0.65–1.82 × 0.37–0.56 mm, lie one behind the other with flat contact surfaces, in the middle third of the body. Before joining the voluminous seminal vesicle, each vas efferens forms an elongate club-shaped vesicle, which is up to 1.0 mm long by 0.25 mm broad and lies close side by side on the dorsal* side of the syncytial cement gland, which is up to 1.8 mm long and 0.53 mm broad; the contained giant nuclei could not be counted with certainty. The cement reservoir, up to 0.53 mm long by 0.28 mm thick, has a thicker wall and gives rise to a slender duct on either side of its posterior end. The cylindrical Säfftigen's pouch may be as long as 1.0 mm. The muscular bursa cap has no anterior diverticula or posterior rays. The genital bursa may attain a length of 1.4 mm. The terminal male genital pore is about 0.2 mm in maximum breadth.

The spindle-shaped outer egg shell is 35–42 × 9–12 μ, the middle, prolonged at the two poles, 31–33 × 8–10 μ, and the embryo 24–27 × 7–8 μ.

Fig. 29

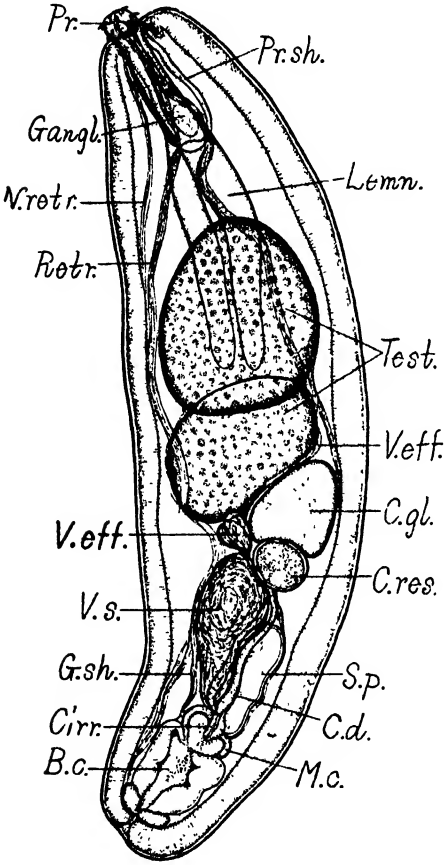

Fig. 30

Fig. 29–30. *Neoechinorhynchus zacconis.*
Fig. 29. ♂, 1.43 mm long.
Fig. 30. Proboscis magnified.

22. *Neoechinorhynchus zacconis* n. sp.

DESCRIPTION. A single male was found on May 15, 1928, in the intestine of *Zacco platypus* (Temm et Schleg.) from Lake Kobata near Kyoto. It is 1.43 mm in length and 0.37 mm in maximum breadth at about the middle. The proboscis, 60 × 48 μ, has three circles of six hooks each, or more accurately six oblique rows of three each; the largest anterior hook is 24 μ, the middle 18 μ, and the posterior 12 μ in length. Inside the apex of the proboscis there is a circle of six small oval muscle plates (r in Hamann's plate III, fig.

*So termed for convenience sake.

28). The elongate oval central ganglion of the proboscis is very conspicuous and about 20 μ broad. The proboscis sheath, 0.2×0.07 mm, has a very thick wall of circular muscle fibers and contains at the base a large elongate oval ganglion measuring $78 \times 36\ \mu$. The paired retinacula and retractors of the proboscis sheath take their origin near the posterior extremity of the proboscis sheath. The lemnisci, 0.54×0.05 mm, extend a little farther backward than the middle of the anterior testis. The ovoid testes lie in close contact with each other at about the middle of the body, the anterior measuring 0.31×0.25 mm and the posterior 0.21×0.24 mm. The paired vesicles of the vasa efferentia, 0.06–0.07×0.05 mm, lie close together in the angle formed by the posterior testis and the cement gland. The elongate pear-shaped vesicula seminalis are 0.11 mm broad, with its broader end directed anteriorly. The syncytial cement gland, approximately triangular and 0.16×0.14 mm in lateral view, is pressed against the posterior testis on its posteroventral side; the number of the contained nuclei could not be ascertained. The spherical cement reservoir, 88 μ in diameter and with a muscular wall about 3 μ thick, lies directly behind the cement gland proper, being partly overlapped by it. The cylindrical Säfftigen's pouch is 0.16 mm long by 0.06 mm broad, and lies directly ventral to the vesicula seminalis between the two ducts of the cement reservoir. The muscular bursa cap is 88 μ broad; the bursal duct at the posterior end of the body are surrounded by very conspicuously developed cells of unknown nature.

Discussion. This species differs from the closely related *N. rutili* (Müller, 1780) chiefly in body size and the length of proboscis hooks. The specific diagnosis is reserved until females are obtained.

On the basis of observation on the two species of *Neoechinorhynchus* described above, I agree with Bieler's statement that the cement gland is "ein grosser, einheitlicher Drüsenkörper von ziemlich ovaler Form" and that "direkt hinter der Kittdrüse ist das Kittreservoir gelegen, welches im Längsschnitt eine rundlich ovale bis dreieckige Gestalt besitzt".

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Abbreviations Used in Figures

B. c. bursa copulatrix
C. d. cement duct
C. gl. cement gland
Cirr. cirrus
C. res. cement reservoir
Gangl. cephalic ganglion
G. m. c. giant muscle cell
G. sh. genital sheath
Lemn. lemniscus
Lig. ligament
M. c. muscular cap of bursa
N. neck
N. retr. neck retractor
Nucl. nucleus of hypodermis

Ov. ovary
Ov. b. ovarial ball
Pr. proboscis
Pr. sh. proboscis sheath
Ret. retinaculum
Retr. retractor of proboscis sheath
Sp. spine
Sph. sphincter
S. p. Säfftigen's pouch
Test. testis
Ut. uterus
Ut. b. uterine bell
Vag. vagina
V. eff. vas efferens
V. s. Vesicula seminalis

9. Studies on the Family Didymozooidae (Monticelli, 1888)

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Government Institute for Infectious Diseases. Tokyo Imperial University

CONTENTS

INTRODUCTION

There are but few published accounts in Japan of didymozooid trematodes, which are known to occur on the gill or in the mouth, the mucous membrane of the mouth cavity, esophagus, and intestine, or in the peritoneal cavity or skin of marine fishes or between their muscles.

The following are the principal reports on didymozooids to be found in the published literature: *Monostoma molae* from between the muscles of *Mola mola*, and *Monostoma tenuicolle* from between the muscles of *Lampris luna*, both by Rudolphi (1819); *Octobothrium lanceolatum* (*Mozocraes* Hermann No. 56) on the gill of *Alosa vulgaris*, by F. S. Leuckart (1828); *Monostoma filum* on the gill of *Exocoetus exsiliens*, by Dujardin (1845); *Distoma okenii* encysted on the gill of *Brama rayi*, by A. Kölliker (1849); hermaphroditism of *Distoma okenii* Kölliker (*Distoma filicolle*), by G. Wagener (1852); *Monostoma bipartitum* encysted on the gill arch of *Thynnus vulgaris*, by K. Wedl (1855); constant occurrence of two individuals, a male and a female, of *Monostoma bipartitum* in a cyst, by G. R. Wagener (1858); *Nematobothrium filarina* from the mouth cavity of *Sciaena aquila*, by P. J. van Beneden (1858); the presence of a lid in the egg, the absence of cilia on the larva and the occurrence of hooks and calcareous bodies in the developmental forms of *Nematobothrium filarina* van Beneden, by J. J. Steenstrup (1860); *Didymozoon scombri* n. g. n. sp. encysted in pairs on the gill cover of *Scomber colias*, *Didymozoon pelamydis* n. sp. from the gill of *Pelamys sarda*, *Didymozoon sphyraenae* from the mucous membrane of *Sphyraena vulgaris*, *Didymozoon auxis* from the gill

of *Auxis Rochei* and *Didymozoon thynni* from the gill of *Thynnus vulgaris*, by E. O. Taschenberg (1879); *Didymozoon taenioides* n. sp. from the muscle of *Mola mola*, and *Didymozoon serrani* n. sp. from the gill of *Serranus fimbriatus*, by Monticelli (1888); *Nematobothrium guernei* n. sp. from the muscle and intestine and also free or encysted on the gill of *Thynnus alalonga*, by R. Moniez (1890); *Didymozoon lampridis* n. sp. from the gill of *Lampris guttatus*, by E. Lönnberg (1891); *Didymozoon benedeni* n. sp. from the gill of *Mola mola*, by Monticelli (1893); *Didymozoon exocoeti* n. sp. from *Exocoetus volitans*, by C. Parona and Perugia (1893); *Koellikeria* sp. from the intestine of *Scomberomorus maculatus*, by Edw. Linton (1901); *Didymostoma bipartitum* (Wedl), *Didymocystis reniformis* n. g. n. sp., *Didymocystis wedli* n. sp. and *Didymozoon pretiosus* n. sp., from the gill of *Thynnus thynnus*, by V. Ariola (1902); *Didymozoon micropterygis* n. sp. from the head of *Seriola dumerili*, by S. Richiardi (1902); *Didymozoon* sp. from the gill of *Mola mola*, by Maclaren (1903); *Didymozoon* sp. from the gill of *Pseudoserranus louti*, by T. Odhner (1907); *Nematobothrium* sp. from the gill of *Sarda sarda*, by Linton (1913); *Atalostrophion sardae* n. g. n. sp. from the gill of *Sarda sarda*, and *Atalostrophion promicrops* n. sp. from the gill of *Promicrops guttatus*, by G. A. MacCallum (1915); *Koellikeria xiphiados* n. sp. from the gill cavity and muscle of *Xiphias gladius*, *Koellikeria scomberomori* n. sp. from the stomach of *Scomberomorus maculatus*, and *Koellikeria haemuli* n. sp. from the gill of *Haemulon flavolinea*, by G. A. MacCallum and W. G. MacCallum (1916); *Atalostrophion epinepheli* n. sp. from the gill of *Epinephelus striatus*, by G. A. MacCallum (1917); *Didymozoon* sp. from the gill of *Scomber japonicus*, by H. Kobayashi (1921), afterwards named *Didymocystis kobayashii* by Dollfus (1926); *Wedlia katsuwonicola* n. sp. from the gill, mouth cavity, esophagus and stomach of *Katsuwonus pelamys*, by Y. Okada (1926). There are many other mentions of didymozooids, but no species other than those mentioned above are dealt with.

The didymozooids live sometimes single but mostly encysted in pairs, and may be hermaphroditic or gonochoristic. When hermaphroditic one of the pair has the male organs more or less atrophied and the female organs well developed, while the other one shows the reverse condition, so that the former is the female and the latter the male.

My studies have led me to conclude that *Wedlia katsuwonicola* Okada and *Didymocystis kobayashii* Dollfus are one and the same species, and I have changed its name to *Didymocystis katsuwonicola* on the basis of its anatomy detailed further on. I have also been able to make out the life history of this species and have attempted a revision of the Didymozooidae as represented in my materials, because the classifications of Braun, MacCallum and Dollfus appear to me unsatisfactory. I have laid weight in the first place on body form and sexual organs. *Nematobothrium*, *Atalostrophium* and *Gonapodasmius* n. g. have elongate thread-like or ribbon-like body, while *Didymozoum*, *Didymocylindrus* n. g., *Didymoproblema* n. g., *Lobatozoum* n. g., *Didymocystis* and *Köllikeria* have cylindrical, fusiform, reniform or globular body.

At this point I want to express my cordial thanks to Professor Emeritus Seitaro Goto for the kindest encouragement and suggestions received throughout the course of this study.

I. *Didymocystis katsuwonicola* (Okada)

1. Nomenclature

I have found a hermaphroditic trematode of the genus *Didymocystis* with an elongated thread-like forebody and a cystiform hindbody, encysted in pairs in the epidermis of the gills of certain marine fishes. One of the pair in each cyst is smaller and has the female organs more or less atrophied and the male organs well developed, while the other one is larger and has the female organs well developed and the male organs more or less rudimentary, so that they are male and female. A study of the internal anatomy of this worm has convinced me that it is identical with *Didymocystis kobayashii* Dollfus described by H. Kobayashi from the gills of *Scomber japonicus*, and with Okada's *Wedlia katsuwonicola* from the gills, mouth cavity and stomach of *Katsuwonus pelamys*. Certain confusions into which these authors have fallen about the genital organs, will be pointed out later on. The host fishes so far known of this worm are *Katsuwonus vagans* Temminck et Schlegel, *Scomber japonicus* Houttuyn, *Seriola quinqueradiata* Temminck et Schlegel, and *Thynnus orientalis* Temminck et Schlegel. A thoroughgoing search of many examples of *Scomber japonicus* and *Katsuwonus vagans* (=*K. pelamys*) has not brought to light any didymozooid agreeing with *Didymocystis kobayashii* Dollfus or *Wedlia katsuwonicola* Okada. According to the "International Rules of Zoological Nomenclature" the correct name for the worm before us should be *Didymocystis katsuwonicola* (Okada, 1926).

2. Description

The oval cyst lying with its long axis parallel to the gill varies from 2.0 to 4.0 mm in length and from 1.5 to 3.0 mm in breadth according to its growth stage, and looks yellowish brown owing to the contained worms. The cyst itself is transparent and apparently composed of connective tissue. The two worms in each cyst are almost similar in form and look somewhat like two commas arranged in a vortex, the head of one apposed to the hind end of the other. The slender forebody arises from between two lobes of the hindbody which is shaped like a mammalian stomach and has a two-lobed anterior and a bluntly pointed posterior end. In the female the forebody is ca. 0.99 mm long and 0.11

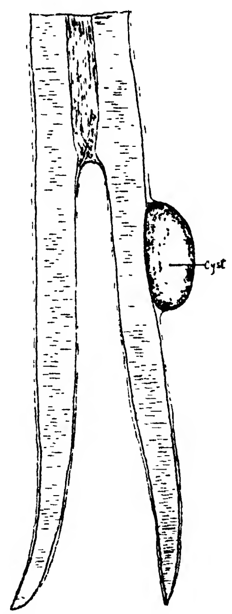


Fig. 1. Cyst of *Didymocystis katsuwonicola* in gill epidermis.

mm wide, while in the male it is ca. 0.64 mm long and 0.095 mm wide. The hindbody is ca. 3.18 mm long and ca. 1.11 mm in maximum breadth in the

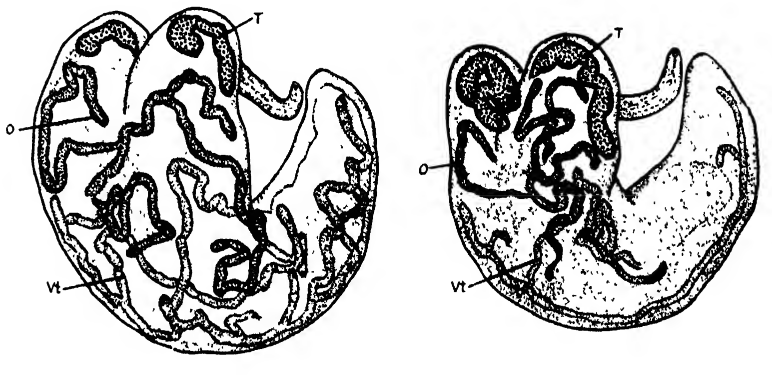


Fig. 2. *Didymocystis katsuwonicola*; lateral view.

female, and ca. 1.91 mm long by ca. 0.56 mm in maximum breadth in the male (fig. 1, 2).

The slender elongated forebody has at its anterior end a circular muscular oral sucker 0.038–0.047 mm long by 0.028–0.042 mm wide, immediately followed by a spherical or elliptical pharynx 0.033–0.038 mm long and 0.028–0.042 mm wide. The esophagus is 0.14–0.31 mm long and terminates a little in front of the middle of the forebody. The intestinal ceca run backwards from this point into the hindbody and terminates some distance from the posterior end. The terminal part of the uterus enters the forebody from the hindbody and after some windings opens close to the oral sucker. The vas deferens also follows the same general course and its aperture connects with that of the uterus (fig. 3).

As mentioned above, the hindbody has the form of a mammalian stomach, and its anterior end is produced into two rounded lobes, between which the origin of the forebody lies. The slightly tapering posterior portion of the hindbody terminates like a blunt beak. There are many cells in the subcuticle of the hindbody and some muscle cells where the two portions of the body run into each other.

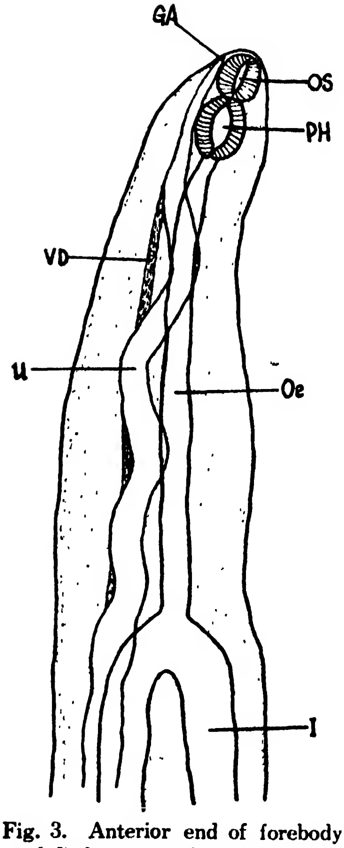


Fig. 3. Anterior end of forebody of *Didymocystis katsuwonicola*.

Male Organs

The elongated testes lying in the anterior

lobes of the hindbody are larger in the male than in the female. Each of them gives rise to a vas efferens, which unites with its fellow into a vas deferens opening at the genital aperture. The general arrangement of the organs are similar in both sexes. In the male the testes are ca. 0.72 mm long by 0.064 mm wide; in the female ca. 0.56 mm by 0.048 mm.

The testes are filled with polygonal cells ca. 0.0035 mm in diameter produced from the peripheral mother cells. They move towards the central parts of the testes, where they gradually become elongated and are transformed into filiform spermatozoa with a round head and ca. 0.017 mm long. In young stages the nuclei of the polygonal cells stain deeper with hematoxylin than the ova. The mature spermatozoa appear to follow the central part of the testis towards the vas efferens (fig. 4, 5).

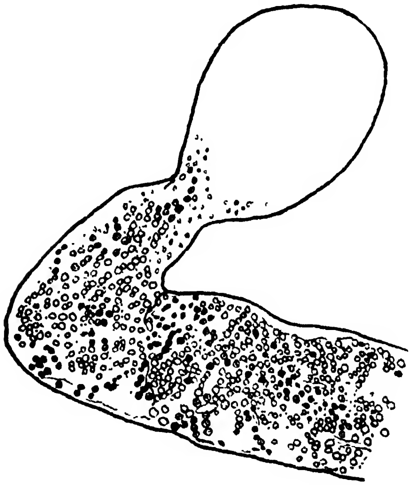


Fig. 4. Longitudinal section of testis of *Didymocystis katsuwonicola*, to show testicular tissues.

Fig. 5. Section of testis of *Didymocystis katsuwonicola*, to show spermatozoa and mother cells.

Female Organs

The long slender anastomosing ovary looking like creeping plant roots lies under the cuticle in the anterior half of the hindbody and measures 0.033–0.042 mm across in the female. It is less branched in the male and measures only 0.024–0.028 mm across. Soon after leaving the ovary, the oviduct is enlarged into the ootype surrounded by the shell gland.

The ovary is filled with polygonal ova ca. 0.0029 mm in diameter, produced from the peripheral mother cells and containing circular nuclei stained deeply by hematoxylin. The young ova move towards the center of the ovary, become polygonal and attain the diameter of ca. 0.0059 mm, when the nuclei are more weakly stained than before and the cytoplasm increases in bulk. At the very center of the ovary, the ova are as large as 0.0078 mm in diameter and have weakly stained nuclei and bulky cytoplasm. They move on into the

oviduct, where they grow still larger and become oval and have the diameter of 0.0088–0.0098 mm (fig. 6, 7, 8, 9).

Fig. 6

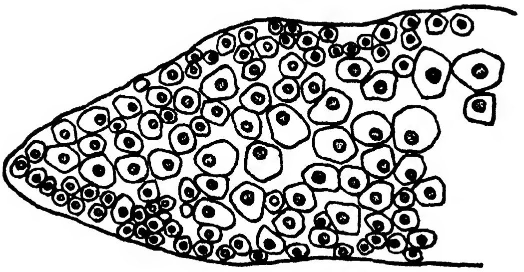


Fig. 7

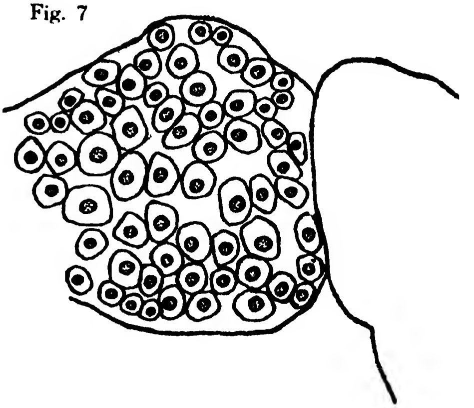


Fig. 8

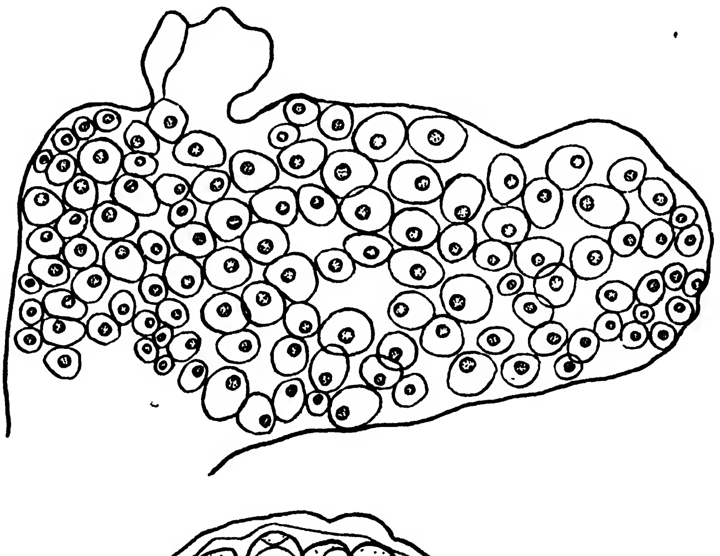


Fig. 9

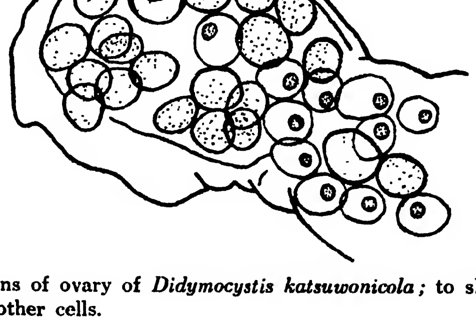


Fig. 6–9. Sections of ovary of *Didymocystis katsuwonicola;* to show young eggs and their mother cells.

Vitellarium. The long sinuous vitellarium looking similar to the ovary lie in the posterior two thirds of the hindbody. In the female it consists of several anastomosing parts 0.033–0.047 mm across; in the male the parts are less numerous and measure only 0.019–0.024 mm across.

The young vitelline cells produced from the peripheral mother cells are polygonal, ca. 0.0049 mm in diameter and contain grayish yellow granules in the cytoplasm. As they move towards the center of the gland, they come to attain the diameter of 0.0088 or even 0.011 mm. The nuclei of the young cells stain but slightly with hematoxylin and completely lose their affinity for stains when ripe, becoming grayish yellow (fig. 10).

Fig. 10. Longitudinal section of vitellarium of *Didymocystis katsuwonicola.*

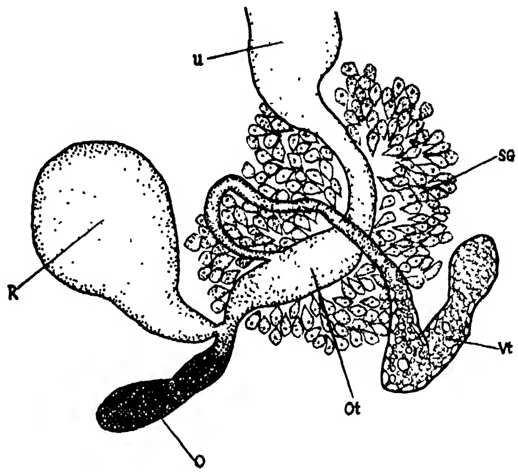


Fig. 11. Ovarian comlex of *Didymocystis katsuwonicola;* reconstructed from serial sections.

Uterus. The greater part of the uterus, which begins at the ootype, lies in the hindbody and only the terminal portion enters the forebody and opens outside close to the oral sucker. The whole uterus is filled with millions of eggs, which become yellow as they move on and are yellowish brown in the terminal portion and impart their color to the whole hindbody. The fully ripe eggs are broadly bean-shaped, measure 0.017–0.019 mm in length by 0.011–0.012 mm in breadth and have double shells, with the larvae lying inside. The uterine reservoir, ca. 0.477 mm by 0.143–0.239 mm, lies in the posterior half of the hindbody and is larger in the male than in the female (fig. 11, 12).

I think that in Okada's description the testes were confused with the ovary, and in Kobayashi's the ovary with the testes.

Seminal Receptacle. The oval seminal receptacle, ca. 0.212 mm by 0.165 mm, lies in the anterior two fifths of the hindbody and sends out a short duct which unites with the oviduct (fig. 11, 12).

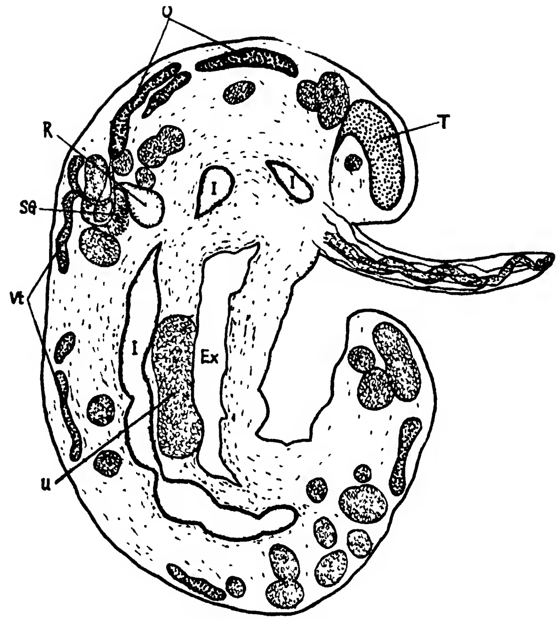


Fig. 12. Longitudinal section of *Didymocystis katsuwonicola*.

Shell Gland. The shell gland, ca. 0.188 mm by ca. 0.141 mm, lies near the seminal receptacle and is traversed by the oviduct. It is in the ootype that the egg shell is formed (fig. 11, 12).

Excretory Organs

The main excretory duct runs along the inner side of the hindbody and opens at its posterior end; only the more slender ducts are present in the forebody. The wall of the ducts is composed of epithelial cells. There is no stainable substance in the lumen (fig. 12).

Digestive Organs

The mouth surrounded by the oral sucker is followed by the pharynx and this by the esophagus, which terminates at about the middle of the forebody, whence the ceca run backwards into the hindbody for about three fifths of its length, on either side of the median line, with a width of ca. 0.188 mm. The ceca are lined with epithelial cells which stain deeply with hematoxylin, and the lumen contains collagenous substances but slightly stained by eosin and sometimes looking brown (fig. 12).

3. Life History

The Formation of the Definitive Egg

The following observations were made on sectioned worms stained with Ehrlich's hematoxylin and eosin, and also on fresh, teased-out eggs.

We already know that the young ova move on from the peripheral part of the ovary to its center, where they grow as large as ca. 0.0088–0.0098 mm in diameter and have weakly stained nuclei. Thence they proceed into the oviduct and on into the ootype, in which they become enclosed by the egg shell together with a number of vitelline cells. At this stage the ovum is colorless and transparent and ca. 0.0118 mm in length and ca. 0.0088 mm in breadth; the nucleus is weakly stained by hematoxylin. The space between the shell and the ovum looks transparent. The vitelline cell which was as large as ca. 0.011 mm in diameter in the gland is after enclosure in the egg shell only 0.0059–0.0078 mm in diameter; perhaps it undergoes fragmentation in the oviduct.

The Formation of the Larva

The definitively formed egg is almost colorless and transparent in the initial part of the uterus and the ovum is slightly stained by hematoxylin. As it moves forwards, cleavage takes place and two, three, four, five,. . . .cells are formed, with the polar bodies at or near one end. These blastomeres are globular and show increasing affinity for hematoxylin. In the meanwhile the egg grows larger, and as the blastomeres become more numerous the shell which was colorless for a short while at the beginning of the uterus, when there were only three or four blastomeres, become yellow and finally yellowish brown. As cleavage goes on further the egg slightly increases in size. When the blastomeres have increased to over thirty, they become polygonal by mutual pressure, while those at the two ends of the embryonic body become gradually flattened. The polygonal blastomeres then coalesce into a central mass, while the flattened cells at the front end form the rounded head and those at the opposite end form the recurved tail. The larva is now complete, with the oral sucker at the anterior end surrounded by radially arranged cilia, and the tail at the posterior end. In the shell it has the form of L and contains many granules staining deeply with hematoxylin. The egg containing fully formed larva measures 0.017–0.019 mm in length and 0.010–0.012 mm in breadth (fig. 13).

Postembryonal Development

To observe the further behavior of the larva, the matured egg was placed in 3.5% salt solution on the slide at the temperature of 10–15°C, which is nearly the milieu in which the parasite lives in nature.

Within the shell the larva executes active motion by rotating around the long axis of the body and opening the mouth, while the cilia around the latter vibrate. In twenty four hours the head end of the egg shell opens and liberates the larva, the latter coming out with the head first and the body and tail following. Once out of the shell, the larva moves slowly by expanding and contracting the body and executes leech-like locomotion by alternately attaching and liberating the oral sucker to and from the substratum or floating object.

Larva in the Gill Epidermis

It is extremely difficult or wellnigh impossible to actually observe the penetration of the larva into the epidermis of the gill to develop to the adult, although I have made several thousand preparations likely to show it. It must come about by the adherence of the larva to an appropriate place of the gill while carried about by the respiratory current. I have however been able to obtain several stages of the larva already partly lying in the epidermis, which show that it enters the epidermis with the head first and that the body and tail follow afterwards. In this stage the larva is ca. 1.034 mm long and 0.095 mm broad or larger. Arrived at its destination, it bends the anterior part of its body preliminary to swelling up, and the gill epidermis shows an external elevation, the first sign of the future cyst. When the larva becomes rounded, it produces a membrane round it. Then another larva comes along and enters the cyst in the same way as the first one and also becomes rounded

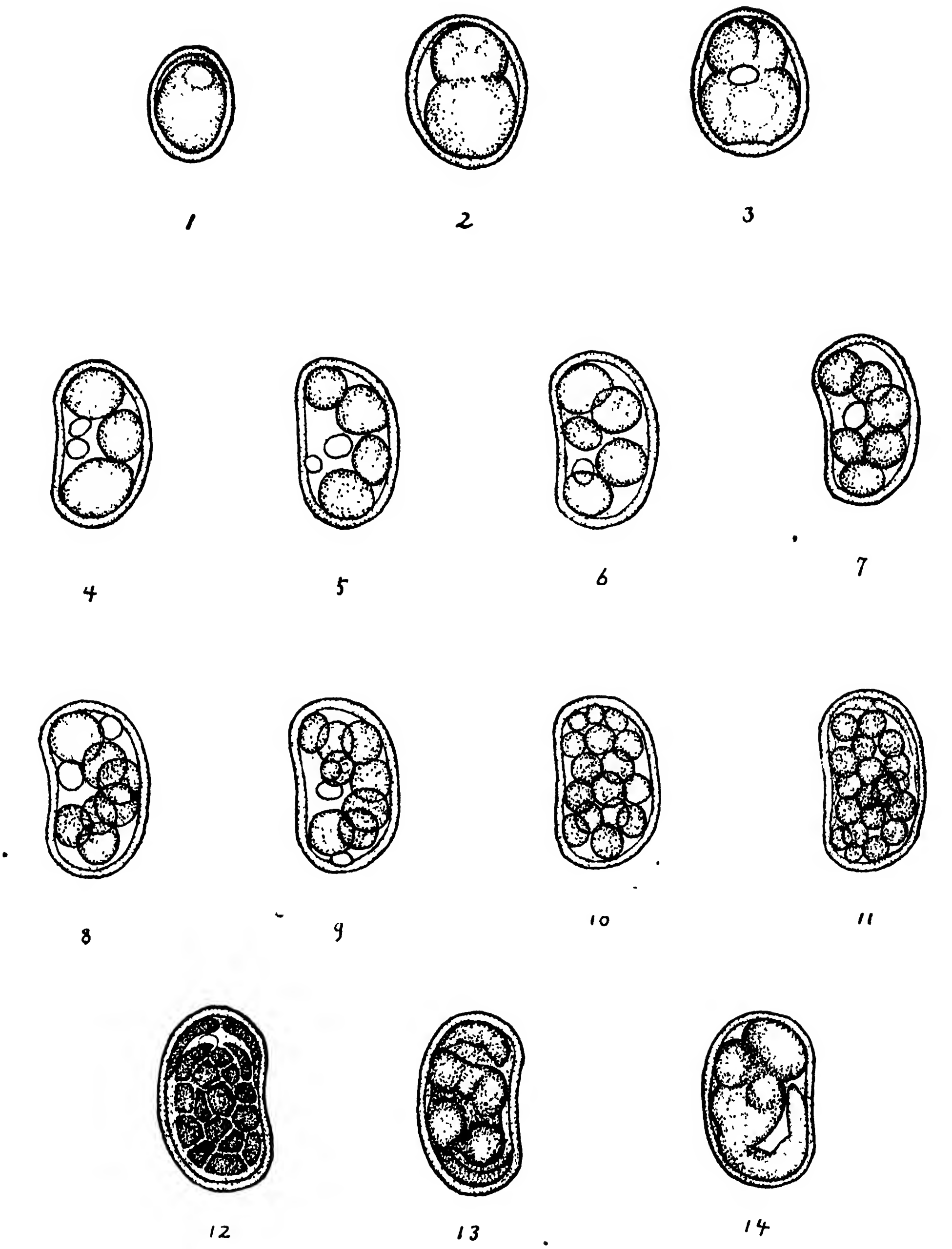
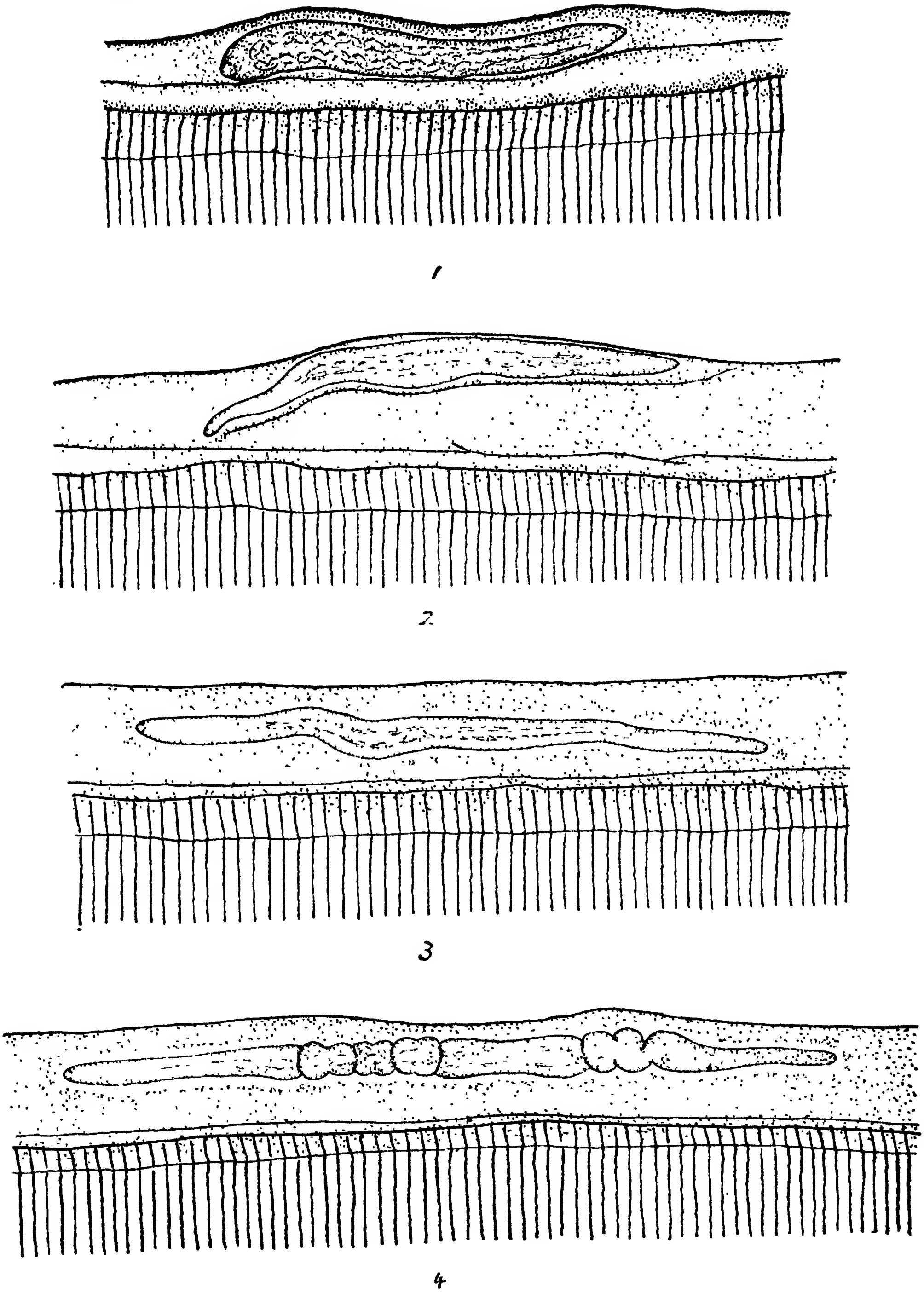
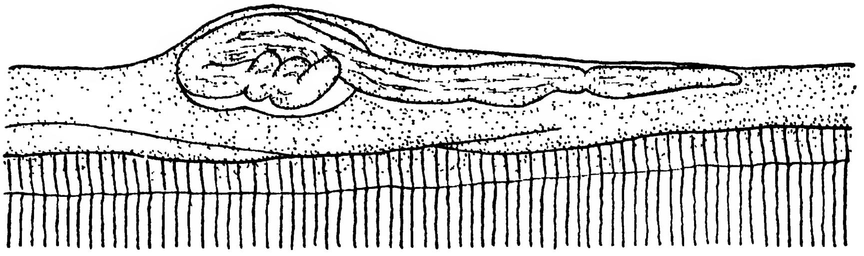


Fig. 13, *1–14*. Embryonal development of *Didymocystis katsuwonicola*.

like it, the two forming the figure of two commas arranged in a vortex. The cyst is now ca. 0.875 mm long by ca. 0.398 mm broad, and its wall looks like connective tissue (fig. 14).

Fig. 14





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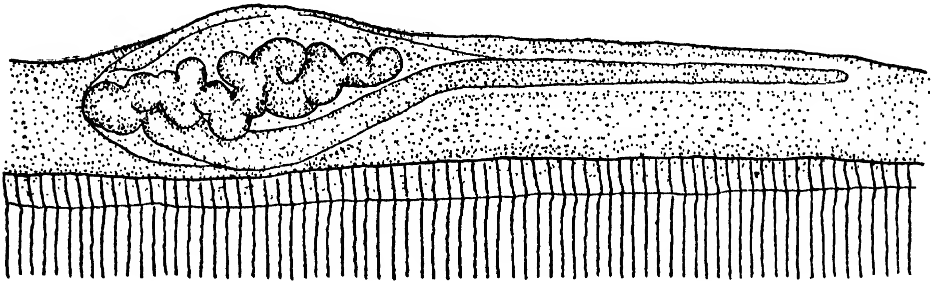

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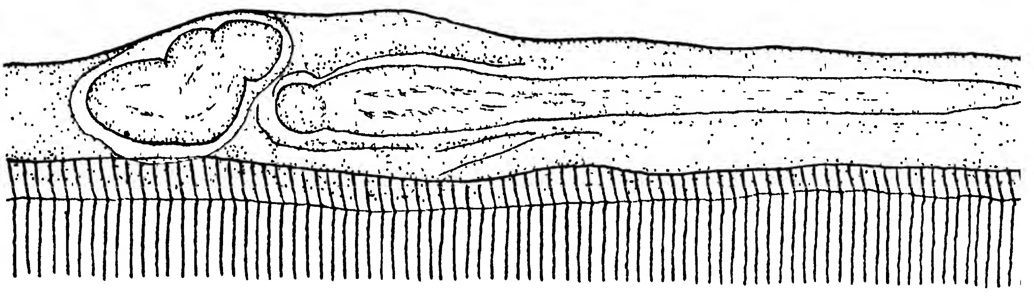

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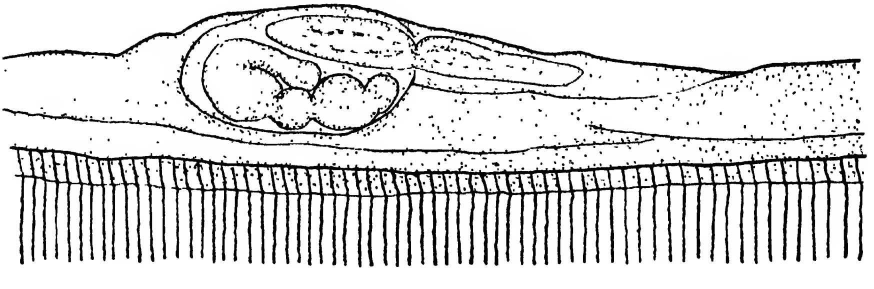

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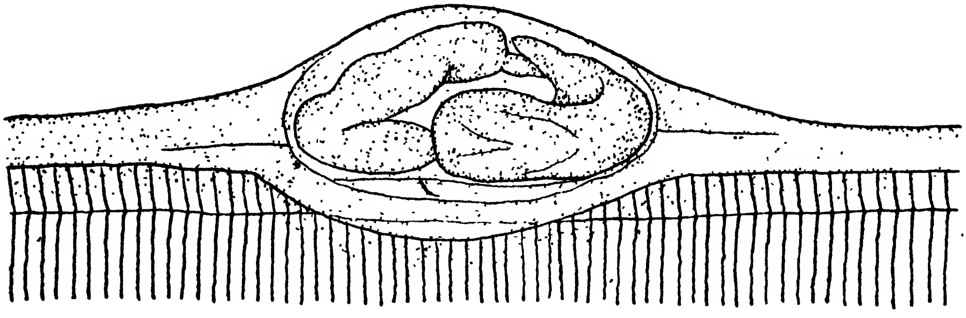

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Fig. 14, *1–9*. *Didymocystis katsuwonicola;* to show the successive entrance of two larvae into the gill epidermis to form a cyst.

Genesis of the Sexual Organs

In the larva penetrating the epidermis, the oral sucker is situated at the anterior end of the body and is followed by the esophagus and the ceca which wind backwards to the posterior end of the body. When the larvae in a cyst become rounded, the esophagus terminates at the middle of the forebody and the straight long simple ceca extend backwards in a sinuous course to the middle of the hindbody.

The digestive organs begin to appear in the larva, but the sexual organs are as yet entirely absent. When the two worms have already formed a vortex, the excretory organs are also to be seen.

Of the sexual organs, the testes are the first to appear and are found in the anterior part of the hindbody in both worms of a cyst. Then the ovary appears in the posterior part of the hindbody and is followed by the vitellarium in the posterior part of the hindbody. The uterus comes to view next and not long afterwards the eggs begin to appear. The worms do not grow considerably at first, but as the sexual organs become developed the body becomes gradually larger and one of the two worms in a cyst outstrips the other in size. They are both hermaphrodites, but in the larger one the testes are smaller than in the other; it is the female. As growth goes on the difference in body size becomes more pronounced and the differentiation into male and female is accomplished.

II. Classification

1. Historical Review

Older authors included the Didymozooidae under *Monostoma* or *Distoma.* Monticelli (1888) was the first to erect a family for them, which he called Didymozoonidae and which Braun (1879–93) characterises as follows:

Digenetische (?) Trematoden, die stets zu zweien in Cysten eingeschlossen leben, ohne Trennung der Geschlechter; Vorderkörper halsartig verjüngt,

hinterer Körperteil cylindrisch oder nierenförmig angeschwollen, mitunter sind die beiden Individuen verwachsen. Nur Mundsaugnapf vorhanden, Pharynx rudimentär oder fehlend, Darm vorhanden oder fehlend. Genitalporus vor dem Mundsaugnapfe, terminal; der Hoden ist ein stark gewundener Schlauch, dessen Windungen vom Uterus begleitet werden. Eier sehr zahlreich, ohne Filamente. Auf der äusseren Körperoberfläche oder in Mund- und Kiemenhöhle resp. im Körper von marinen Fischen lebend.

Poche (1907) writes the family name "Didymozoidae"; he says with reference to Monticelli's name "Didymozoonidae", "da das n im Auslaute des Namens ihrer typischen Gattung, *Didymozoon* O. Taschenberg, nicht zum Stamme gehört und das auslautende ο bei den Stämmen der 2. Deklination bei Anfügung der Endung *idae* bekanntlich eliminiert wird".

G. A. MacCallum (1916) has revised the family and called it Koellikeriadae.

As to the orthography of the family name, I would write it "Didymozooidae", to conform to Art. 4 of the "International Rules of Zoological Nomenclature", the stem of ζωον being ζωο and not ζωον or ζω; and this spelling appears also to be sanctioned by usage, because we write "zoöid" (English), "zooïd" (French) and "Zooide" (German). The form "zoïde" is used in French for the animal colony formed by budding (Larousse). Further, "Koellikeriadae" should be written "Köllikeriidae", "*Atalostrophion*" "*Atalostrophium*" and "*Didymozoon*" "*Didymozoum*" to conform to the "International Rules".

Up to the present there have been described six genera, *Nematobothrium*, *Didymozoum*, *Köllikeria*, *Wedlia*, *Didymocystis* and *Atalostrophium*, the characters of which may be seen from the following notes.

Nematobothrium van Beneden, 1858

Van Beneden (1858) found in *Sciaena aquila* *Nematobothrium filarina*, a worm 1 meter long, encysted in tangled pairs and without any connection with the outside. The body is long, round, soft, shows no segmental foldings, and is tightly invested by a mantle; at one end is an excavation which is not a sucker and at the other, which is more truncated, is another excavation of a different form. There is no ventral sucker. No trace of intestinal canal could be found, but it is thought that it has probably undergone atrophy by the extraordinary development of the genitalia.

Maclaren (1903) characterizes *Nematobothrium* as follows. Much elongated Distomidae with small pear-shaped pharynx and without oral sucker. Mouth at the anterior extremity and a small ventral sucker not far from it; simple bifurcated intestine; excretory canal bifurcated at anterior end and not anastomosed around pharynx. Hermaphrodites; ovary long and tubular; 2 long tubular vitellaria; eggs without filament; 2 long tubular testes without special penis. Genital canals opening separately on a papilla somewhat behind the mouth. Laurer's canal? Encysted in pairs on the gills or in the flesh of marine fishes.

According to G. A. and W. G. MacCallum (1916), the trematodes of this genus are greatly elongated forms living in the mature state in pairs in cysts in gills or flesh of marine fishes; digestive tract in various degrees of retrogression; hermaphrodite but tending to retrogression of one sex in each individual; genital opening directly behind mouth at cephalic extremity; ovary and vitellarium in form of long coiled cords; shell gland and seminal reservoir well developed; uterus forming extremely long coiled tube; single testis and vas deferens and rudimentary penis.

Braun (1879–1893) says, "Sehr lang gestreckte Didymozooniden ohne Darm, doch mit Mundöffnung, Genitalporus am Kopfende".

Didymozoon Taschenberg, 1878

Taschenberg (1878–1879) included in this genus worms with elongated or kidney-shaped body, two forming a ring, with a distinct, often thread-like neck but without suckers; pharynx spherical or oval, intestine present or absent; testes tubular and much convoluted; coiled uterus extending with the testes throughout the body and containing millions of small oval eggs with chitinous shell.

According to Braun (1879–1893), "Darm gewöhnlich vorhanden und gegabelt, Mundsaugnapf oval oder kuglig, Körper von verschiedener Form".

Köllikeria Cobbold, 1860

Cobbold (1860) characterizes this genus thus. "Sexus discretus. Corpus maris filiforme antrorsum clavatum, retrorsum sensim attenuatum. Os acetabuliforme orbiculare. Acetabulum ventrale sessile. Apertura genitalis inter os et acetabulum. Corpus feminae antrorsum filiforme clavatum, retrorsum subito increscens, reniforme. Apertura genitalis inter os et acetabulum".

Braun (1879–1893) says, "Getrenntgeschlechtliche Distomiden, die in geschlechtsreifem Zustande in Kapseln zu zweien (♂♀) leben. Das Männchen ist fadenförmig, vorn etwas verbreitert, nach hinten sich zuspitzend, die gleiche Anschwellung des Vorderendes zeigt das Weibchen, doch ist der hintere Körperteil desselben stark verdickt und von etwa nierenförmiger Gestalt. Die Geschlechtsöffnung liegt bei beiden Geschlechtern zwischen Mund- und Bauchsaugnapf. Parasiten in der Mund- und Kiemenhöhle bei Fischen".

G. A. MacCallum's (1915) diagnosis. "Digenetic trematodes living in pairs in cyst. Hermaphrodite but sexually distinguishable by the outer form and by the predominance in each of the genital organs of one sex with obsolescence of the others. Anterior part of body narrow, posterior part cylindrical or swollen into kidney shape: sometimes two individuals are grown together. Suckers rudimentary or feebly developed. Both may be present or one or both may be absent. Pharynx and intestine may be rudimentary or absent. Genital opening near the mouth. Ovary and yolk gland long convoluted tubes, meeting in a shell gland at beginning of long tubular uterus. Eggs yellow

and round. Testes saccular or tubular with long convoluted vas deferens. No muscular cirrus. Many forms are supplied with a nutritive vascular film for the host ".

Wedlia Cobbold, 1860

Cobbold's diagnosis (1860) is as follows. " Corpus inerme, reniforme, lobatum, aliquando antrorsum attenuatum, apice incrassatum clavatum, retrorsum subito increscens. Os terminale acetabuliforme. Acetabulum ventrae nullum. Androgyna (?) apertura genitale infra os. Oviparum, ovulis non operculatis, avium incola et in cavo branchiarum piscium marinarum gemmatim in folliculis inclusum ".

Didymocystis Ariola, 1902

V. Ariola (1902) erected this genus for trematodes from *Thynnus vulgaris* and *Thynnus tunnina*, with the following diagnosis. " La forma del loro corpo si allontana notevolmente da tutti i *Didymozoon* conosciuti, tuttavia la caratteristica distinzione del corpo in due regioni differenti, l'una cefalica, filiforme, l'altra abdominale, notevolmente ingrossata, fa collocare questa specie nel gen. *Didymocystis*.

Atalostrophion G. A. MacCallum, 1915

G. A. MacCallum (1915) erected this genus with the following characters. " Extremely elongate delicate band-like worms, living in tangled masses under the mucous membrane of the branchial cavities of fishes. Digestive tract well developed and bifurcated. Acetabulum sometimes present. Hermaphrodite, both sets of organs being well developed. Genital pore near the mouth. Ovary and testes tubular. Shell gland and seminal reservoir well developed. Vitellaria long and tubular ".

So far there have been but few attempts at classification of these trematodes. Here is one by Braun (1879–1893).

Family Distomidae
- Genus *Köllikeria* Cobbold, 1859.

Family Didymozoonidae Monticelli, 1888.
- Genus *Didymozoon* Taschenberg, 1879.
- Genus *Nematobothrium* van Beneden, 1858.

G. A. MacCallum (1917) included cylindrical, globular and reniform trematodes in *Köllikeria*, elongate, thread-like ones in *Nematobothrium*, and ribbon-like ones in *Atalostrophion*. His scheme is

Family Didymozoidae Poche, 1907.
- Genus *Köllikeria* Cobbold, 1860.
- Genus *Nematobothrium* van Beneden, 1858.
- Genus *Atalostrophion* G. A. MacCallum, 1916.

Dollfus' (1926) scheme is more elaborate.

1. Group. Body elongated, sometimes a little cylindrical and a little flattened but not ribbon-like. Hindbody not large.
   - a) *Didymozoon.* Hermaphrodite. Oral sucker and rudimentary pharynx. Lodged in cyst. Living under skin and mucous membrane without making xenocyst. Two individuals, alone or in group.
   - b) *Didymozoön.* Gonochorism. Living in pairs. The female larger than the male.
2. Group. Forebody elongated, hindbody swollen.
   - a) Complete hermaphrodite. Living in pairs in cyst. Two individuals almost similar in form.
     - a_1) *Didymozoon.* Hindbody elongated and swollen, sometimes cylindrical or flattened.
     - a_2) *Didymocystis.* Hindbody remarkably swollen, reniform or globular.
   - b) Complete gonochorism. The female has only rudimendary male organs. Living in pairs in cyst. Two individuals not similar in form. Male always very small.
     - b_1) *Wedlia.* No ventral sucker. Male with rudimentary female organs.
     - b_2) *Koellikeria.* Oral and ventral suckers present. Male without any female organs whatever.
3. Group. Body small, very elongated, not ribbon-like. Hindbody not globular.
   - a) Hermaphrodite. One worm a little larger. Living in pairs in cyst.
     - a_1) *Nematobothrium.* Two individuals different in form. No ventral sucker.
     - a_2) *Nematobothrium.* Two individuals similar in form. No ventral sucker.
   - b) *Nematobothrium.* Hermaphrodite. Living not in cyst but free in intestine, mucous membrane of mouth or muscle; not in pairs. No ventral sucker.
4. Group. *Atalostrophion.* Body very elongated, flattened or ribbon-like. Complete hermaphrodite. Living under mucous membrane of gills; not in cyst nor in pairs. Ventral sucker present or absent.

2. Revision, with Keys to Subfamilies, Genera, Subgenera and Species

So far I have obtained eighteen didymozooid species in Japan. A comparative study of them and the published descriptions of already known forms has led me to the conclusion that none of the classifications proposed is satisfactory. I will therefore submit a new one, in which weight has been placed on body form, the presence or absence of the ventral sucker, and the separation or union of the sexes. I propose for the group four new subfamilies, ten genera

with four new ones, and six new subgenera; but before doing so I will make some remarks on the genera variously adopted by preceding authors.

The genus *Nematobothrium* of van Beneden (1858) included hermaphroditic forms with elongated, thread-like body destitute of a distinct demarcation into forebody and hindbody. In agreement with MacCallum (1915) I propose to limit the genus *Nematobothrium* to species with elongated, thread-like bodies, and further to divide it according to the presence or absence of the ventral sucker into two subgenera, *Maclarenozoum* and *Benedenozoum*.

Atalostrophium MacCallum (1915) includes only elongated, ribbon-like forms. I propose to divide it also according to the presence or absence of the ventral sucker into two subgenera, for which I propose the names *Maccallozoum* and *Atalosparganum*. They are both hermaphrodites.

I propose a new genus *Gonapodasmius* for forms like *Nematobothrium* but differing from it by the sexes being separate.

Didymozoum Taschenberg (1878) included forms with thread-like, cylindrical bodies as well as those with cystiform bodies, all with the forebody sharply marked off from the hindbody. I would limit it to species with cylindrical bodies.

Didymocylindrus n. g. includes species with cylindrical bodies and the forebody connecting with the hindbody at its middle part. It differs from *Didymozoum* in the manner in which the two body portions are connected.

Didymoproblema n. g. is proposed for those forms which have a long, filiform process at one end, by which they are attached to the host.

For those forms whose hindbody is multilobed, I propose the name *Lobatozoum* n. g.

Didymocystis Ariola (1902) includes species with reniform, semiglobular or comma-shaped hindbody. The separation of the sexes is imperfect.

Köllikeria Cobbold (1860) included forms with oval, reniform or globular bodies, separate sexes and ventral sucker, while *Wedlia* Cobbold (1860) included similar forms without ventral sucker. Ariola's *Didymostoma* (1902) included only species without ventral sucker. I would make two subgenera, *Köllikeria* and *Wedlia*, in the sense adopted by Kölliker.

Further I propose to divide Didymozooidae into four subfamilies, Nematobothriinae, Gonapodasmiinae, Didymozooinae and Köllikeriinae, with the diagnoses given further on.

I will now proceed to explain my system in detail.

Family Didymozooidae (Monticelli, 1888)

Diagnosis. Hermaphroditic or gonochoristic trematodes encysted in pairs or singly or not encysted. Forebody thread-like; hindbody thread-like, cylindrical, fusiform, multilobed, reniform, semiglobular or globular. Oral sucker, ventral sucker, pharynx and intestine present or absent. Genital pore near oral sucker. Testis tubular. Ovary tubular or rarely oval. Vitellarium tubular. Receptaculum seminis and shell gland present. Laurer's canal absent. Uterus

long, with millions of eggs. Excretory pore at posterior end of body. Parasitic on gills, mouth cavity, esophagus, stomach, muscle or skin of marine fishes.

Key to Subfamilies

1	Hindbody elongated	2
	Hindbody swollen	3
2	Hindbody thread-like or ribbon-like; hermaphrodites	Nematobothriinae
	Hindbody thread-like; gonochoristic	Gonapodasmiinae
3	Hindbody cylindrical, fusiform, reniform or semiglobular; hermaphrodites	Didymozooinae
	Hindbody reniform, oval or globular; gonochoristic	Köllikeriinae

Subfamily Nematobothriinae n.

Diagnosis. Hermaphroditic Didymozooidae with thread-like or ribbon-like fore- and hindbody. Encysted or not, in pairs or not. Two individuals equal or unequal in size. Oral sucker and ventral suckers present or absent. Pharynx and intestine present or absent. Genital pore near oral sucker. Testis tubular. Ovary tubular or oval. Vitellarium tubular. Receptaculum seminis and shell gland present. Uterus long, with millions of eggs.

Type genus. *Nematobothrium.*

Key to Genera

Body thread-like; with or without ventral sucker; encysted or not	*Nematobothrium*
Body ribbon-like; with or without ventral sucker; not encysted	*Atalostrophium*

Genus *Nematobothrium* van Beneden, 1858

Diagnosis. Nematobothriinae with thread-like body; forebody elongated and connected with thread-like hindbody at one end of it. Neck not sharply marked off. Fore- and hindbody of almost equal breadth. Encysted or not. Two individuals equal or unequal in size. Oral sucker present or absent. Pharynx present. Ventral sucker and intestine present or absent. Testis in hindbody near neck. Ovary and vitellarium tubular. Shell gland and receptaculum seminis at middle part of hindbody.

Type species. *Nematobothrium filarina.*

Key to Subgenera

Without ventral sucker	*Benedenozoum*
With ventral sucker	*Maclarenozoum*

Subgenus *Benedenozoum* n.

Diagnosis. *Nematobothrium* without ventral sucker.

Type species. *Nematobothrium* (*Benedenozoum*) *filarina.*

Key to Species

1	In cyst	2
	Not in cyst	*guernei*
2	With outward appearance of two individuals	*filarina*
	Without outward appearance of two individuals	3
3	Without oral sucker	4
	With oral sucker	5
4	Intestine present	*scombri*
	Intestine absent	*pelamydis*
5	Testis single; body 9 mm long; neck slender	*sardae*
	Testes two; body 20 mm long; neck broad	*sabae*

Nematobothrium (*Benedenozoum*) *filarina* van Beneden, 1858
Synonym. *Psorospermia sciaenae umbrae* Robin, 1853
Nematobothrium (*Benedenozoum*) *sardae* G. A. et W. G. MacCallum, 1916
Nematobothrium (*Bededenozoum*) *guernei* Moniez, 1890
Nematobothrium (*Benedenozoum*) *scombri* (Taschenberg, 1879)
Synonym. *Didymozoum scombri* Tasch., 1879
Nematobothrium (*Benedenozoum*) *pelamydis* (Taschenberg, 1879)
Synonym. *Didymozoum pelamydis* Tasch., 1879
Nematobothrium (*Benedenozoum*) *sabae* n. sp.

Subgenus *Maclarenozoum* n.

Diagnosis. *Nematobothrium* with ventral sucker.
Type species. *Nematobothrium* (*Maclarenozoum*) *molae.*

Key to Species

Ventral sucker relatively small	*molae*
Ventral sucker relatively large	*pristipomatis*

Nematobothrium (*Maclarenozoum*) *molae* Maclaren, 1903
Synonyms. *Nematobothrium molae* Maclaren, 1903
Didymozoum benedenii Monticelli, 1893
Nematobothrium (*Maclarenozoum*) *pristipomatis* Yamaguti, 1934

Genus *Atalostrophium* G. A. MacCallum, 1915

Diagnosis. Nematobothriinae with elongated, ribbon-like body. Singly in gill cavity or mucous membrane of mouth cavity. Hermaphroditic. Fore- and hindbody flattened and almost of equal breadth. Oral sucker present. Pharynx and ventral sucker present or absent. Intestine present. Genital pore near oral sucker. Testis tubular. Ovary and vitellarium long and tubular. Receptaculum seminis present. Shell gland present or absent. Uterus long, with millions of eggs.

Type species. *Atalostrophium sardae*

Key to Subgenera

Without ventral sucker .... *Atalosparganum*
With ventral sucker.. *Maccallozoum*

Subgenus *Atalosparganum* n.

Diagnosis. *Atalostrophium* without ventral sucker; pharynx present or absent. Ovary one or two; uterus single or double.

Type species. *Atalostrophium* (*Atalosparganum*) *sardae.*

Key to Species

1 {Pharynx present; ovaries two, tubular .... sp.
1 {Pharynx absent; ovary single, tubular 2
2 {Body thin and delicate; uterus double .... *sardae*
2 {Body muscular, not so thin and delicate; uterus single .... *promicrops*

Atalostrophium (*Atalosparganum*) *sardae* G. A. MacCallum, 1915
Atalostrophium (*Atalosparganum*) *promicrops* G. A. MacCallum, 1915
Atalostrophium (*Atalosparganum*) sp.

Subgenus *Maccallozoum* n.

Diagnosis. *Atalostrophium* with ventral sucker, but without pharynx.

Type species. *Atalostrophium* (*Maccallozoum*) *epinepheli.*

Atalostrophium (*Maccallozoum*) *epinepheli* G. A. MacCallum, 1917

Subfamily Gonapodasmiinae n.

Diagnosis. Gonochoristic Didymozooidae. Encysted in pairs. Two individuals equal or unequal in size. Body elongated, thread-like. Oral sucker and pharynx present. Ventral sucker absent. Intestine present. Genital pore near oral sucker. Ovary, vitellarium and testis tubular. Receptaculum seminis and shell gland present. Uterus long, with numerous eggs.

Type genus. *Gonapodasmius.*

Genus *Gonapodasmius* n.

Diagnosis. Gonapodasmiinae with characters given above.

Type species. *Gonapodasmius haemuli.*

Key to Species

Live in pairs on pseudobranch, in cyst.............................. *haemuli*
Live in pairs in muscle, not in cyst .... *okushimai*

Gonapodasmius haemuli (G. A. et W. G. MacCallum, 1916)
Synonym. *Köllikeria haemuli* G. A. et W. G. MacCallum, 1916
Gonapodasmius okushimai n. sp.

Subfamily Didymozooinae n.

Diagnosis. Hermaphroditic Didymozooidae. Encysted in pairs. Forebody thread-like; hindbody cylindrical, fusiform, reniform, comma-shaped or semiglobular. Oral sucker present or absent. Ventral sucker absent. Pharynx present. Intestine present. Testis tubular. Ovary and vitellarium tubular. Receptaculum seminis and shell gland present. Uterus long, with millions of eggs.

Type genus. *Didymozoum.*

Key to Genera

1	Hindbody broad, reniform, commaform or semiglobular	*Didymocystis*
	Hindbody cylindrical or fusiform	2
2	Forebody projecting from one end of hindbody	*Didymozoum*
	Forebody projecting from middle part of hindbody	3
3	With a long, filiform process on the hindbody	*Didymoproblema*
	Without any process on the hindbody	4
4	Hindbody multilobed	*Lobatozoum*
	Hindbody without lobes	*Didymocylindrus*

Genus *Didymozoum* Taschenberg, 1878

Diagnosis. Didymozooinae with cylindrical hindbody. Forebody thread-like, projecting from one end of hindbody. Encysted in pairs. Neck sharply marked off from fore- and hindbody. Oral sucker present or absent. Pharynx and intestine present. Ventral sucker absent. Testes tubular, near anterior end of hindbody. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Genital pore near oral sucker. Uterus long, with millions of eggs.

Type species. *Didymozoum sphyraenae.*

Key to Species

1	With quadrilateral expansion at the junction of fore- and hindbody	*pretiosum*
	Without expansion at the junction of fore- and hindbody	2
2	Hindbody long, thread-like	*taenioides*
	Hindbody elongated, cylindrical	3
	Hindbody compressed, with rounded posterior end	4
3	Cyst oval, the pair lying like two commas in a vortex	*auxis*
	Cyst comparatively short, fusiform	*longicolle*
	Cyst long, cylindrical	*filicolle*
4	Neck sharply marked off from fore- and hindbody	*sphyraenae*
	Neck not so sharply marked off from fore- and hindbody	*tenuicolle*

Didymozoum sphyraenae **Taschenberg, 1878**

Synonym. *Monostoma gemellum* Steenstrup, 1860

Didymozoum auxis **Taschenberg, 1878**

Didymozoum pretiosum **Ariola, 1902**

Didymozoum taenioides **Monticelli, 1888**

Synonym. *Monostoma molae* Rudolphi, 1819

Didymozoum tenuicolle (Rudolphi, 1819)
Synonyms. *Monostoma tenuicolle* Rudolphi, 1819
Didymozoum lampridis Lönnberg, 1891
Didymozoum longicolle n. sp.
Didymozoum filicolle n. sp.

Genus *Didymocylindrus* n.

Diagnosis. Didymozooinae encysted in pairs. Hindbody cylindrical. Forebody thread-like and projecting from middle part of hindbody. Oral sucker present. Ventral sucker absent. Pharynx and intestine present. Genital pore near oral sucker. Testes in hindbody, at base of forebody. Ovary and vitellarium tubular. Receptaculum seminis and shell gland present. Uterus long, with millions of eggs.

Type species. *Didymocylindrus filiformis.*

Didymocylindrus filiformis n. sp.

Genus *Didymoproblema* n.

Diagnosis. Didymozooinae encysted in pairs. Forebody filiform and projecting from middle part of fusiform hindbody, which has a filiform process at one end. Oral sucker and pharynx present. Ventral sucker absent. Intestine present. Genital pore near oral sucker. Testes tubular, in hindbody on either side of base of forebody. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Uterus long, with millions of eggs.

Type species. *Didymoproblema fusiforme.*

Didymoproblema fusiforme n. sp.

Genus *Lobatozoum* n.

Diagnosis. Didymozooinae encysted in pairs. Forebody filiform, slightly thickened at front end, projecting from middle part of hindbody. Hindbody elongated, with multilobed margin. Oral sucker and pharynx present. Ventral sucker absent. Intestine present. Genital pore near oral sucker. Testes tubular, connected with each other, at base of forebody. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Uterus long, with millions of eggs.

Type species. *Lobatozoum multisacculatum.*

Lobatozoum multisacculatum n. sp.

Genus *Didymocystis* Ariola, 1902

Diagnosis. Didymozooinae encysted in pairs. Forebody slender, elongated. Hindbody swollen, reniform, comma-shaped or semiglobular. Oral sucker present or absent. Pharynx present. Ventral sucker absent. Intestine present.

Genital pore near oral sucker. Testes tubular, more or less elongated, in hindbody, near base of forebody. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Uterus long, with millions of eggs.

Type species. *Didymocystis thynni.*

Key to Species

1	Forebody projecting from middle part of hindbody	2
	Forebody projecting from hindbody between one end and middle of latter	3
	Forebody projecting from one end of hindbody	4
2	Hindbody rounded, multilobed	*xiphiados*
	Hindbody elongated oval	*simplex*
3	Cyst large; egg small	*scomberomori*
	Cyst small; egg large	*bilobata*
4	Hindbody kidney-shaped	*thynni*
	Hindbody semiglobular	5
	Hindbody like mammalian stomach	6
5	Body large; encysted in periosteum	*semiglobularis*
	Body small; encysted in mucous membrane	*ovata*
6	Hindbody elongated, almost uniform in breadth	*crassa*
	Hindbody comma-shaped, of unequal breadth at different points	7
7	Body large; hindbody relatively broad	*katsuwonicola*
	Body small; hindbody relatively broad	*soleiformis*
	Hindbody relatively slender	*wedli*

Didymocystis thynni (Taschenberg, 1879)

Synonyms. *Didymozoon thynni* Taschenberg, 1879
Didymocystis reniformis Ariola, 1902
Monostoma bipartita Wedl, 1855

Didymocystis wedli Ariola, 1902

Didymocystis xiphiados (G. A. et W. G. MacCallum, 1916)

Synonym. *Köllikeria xiphiados* G. A. et W. A. MacCallum, 1916

Didymocystis katsuwonicola (Okada, 1926)

Synonyms. *Wedlia katsuwonicola* Okada, 1926
Didymocystis kobayashii Dollfus, 1926

Didymocystis scomberomori (G. A. et W. G. MacCallum, 1916)

Synonym. *Köllikeria scomberomori* G. A. et W. G. MacCallum, 1916

Didymocystis semiglobularis n. sp.

Didymocystis bilobata n. sp.

Didymocystis simplex n. sp.

Didymocystis crassa n. sp.

Didymocystis soleiformis n. sp.

Didymocystis ovata n. sp.

Subfamily Köllikeriinae n.

Diagnosis. Gonochoristic Didymozooidae encysted in pairs; male always very small. Forebody elongated. Hindbody reniform, oval or globular. Oral sucker relatively large. Ventral sucker and pharynx present or absent. Intestine present. Genital pore near oral sucker. Testes tubular, only in males.

Ovary and vitellarium tubular, only in females. Shell gland and receptaculum seminis present in females. Uterus long, with millions of eggs, only in females.

Type genus. *Köllikeria.*

Genus *Köllikeria* Cobbold, 1860

Diagnosis. Köllikeriinae encysted in pairs. Forebody spoon-shaped. Hindbody reniform, oval or globular. Oral sucker large. Pharynx present or absent. Genital pore near oral sucker. Testes tubular. Ovary and vitellarium tubular. Shell gland and receptaculum seminis present. Male lodged in a hollow of female.

Type species. *Köllikeria* (*Köllikerizoum*) *filicollis.*

Key to Subgenera

Ventral sucker absent .... *Wedlia*
Ventral sucker present .... *Köllikerizoum*

Subgenus *Wedlia* n.

Diagnosis. *Köllikeria* without ventral sucker. Hindbody oval or globular in both sexes. Hindbody of male lodged in a hollow of that of female.

Type species. *Köllikeria* (*Wedlia*) *bipartita.*

Key to Species

1 {Pharynx absent .... *reniformis*
{Pharynx present 2
2 {Pharynx rudimentary; male easily detachable from female .... *bipartita*
{Pharynx present; male not detachable from female without injuring latter .... *globosa*

Köllikeria (*Wedlia*) *bipartita* (Wedl, 1855)

Synonyms. *Monostoma bipartitum* Wedl, 1855
Didymostoma bipartitum (Wedl, 1855) Ariola, 1902
Didymozoon micropterygis Richiardi, 1902

Köllikeria (*Wedlia*) *reniformis* n. sp.

Köllikeria (*Wedlia*) *globosa* n. sp.

Subgenus *Köllikerizoum* n.

Diagnosis. *Köllikeria* with ventral sucker. Male thin and delicate. Female full of eggs; forebody slightly swollen at anterior end; intestine bifurcated; genital pore behind oral sucker; uterus partly filled with eggs and convoluted in posterior part of body. Male with similar forebody but slender, elongated hindbody; a long uterus without eggs.

Type species. *Köllikeria* (*Köllikerizoum*) *filicollis*

Köllikeria (Köllikerizoum) filicollis (Rudolphi, 1819)

Synonyms. *Monostoma filicolle* Rudolphi, 1819
Distoma filicolle van Beneden, 1858
Distoma okenii Kölliker, 1846
Köllikeria okenii (Kölliker, 1846) Parona, 1912
Köllikeria filicolle (Rudolphi, 1819) Johnstone, 1911

3. List of Didymozooidae with Hosts, Habitats and Localities

Family Didymozooidae

Subfamily Nematobothriinae

Nematobothrium (Benedenozoum) filarina

Sciaena umbra; gill mucosa; France (Robin)
Sciaena umbra; gill mucosa; France (Davaine)
Sciaena umbra; gill cavity; Belgium (Van Beneden)

Nematobothrium (Benedenozoum) scombri

Scomber colias; gill cover; Napoli (Taschenberg)
Scomber colias; ....; Genoa (Parona et Perugia)
Scomber scomber; gill cavity; Venice (Stossich)
Scomber scomber; gill cover; Triest (Stossich)
Scomber scomber; gill cover; Kristineberg (Odhner)
Scomber scomber; gill, mouth; Ireland (Johnstone)
Scomber scomber; mouth cavity; Pétrel (Dollfus et Monod)

Nematobothrium (Benedenozoum) pelamydis

Sarda sarda; gill; Napoli (Taschenberg)
Sarda sarda; ...; Genoa (Parona et Perugia)
Sarda sarda; ...; Portoferrajo (Parona)

Nematobothrium (Benedenozoum) sardae

Sarda sarda; gill; Woods Hole (G. A. et W. G. MacCallum)
Sarda sarda; gill; Woods Hole (Linton)

Nematobothrium (Benedenozoum) guernei

Germo alalonga; gill, intestine, muscle; Gascony (Moniez)

Nematobothrium (Benedenozoum) sabae

Scomber japonicus; gill epidermis; Tokyo (Ishii)

Nematobothrium (Maclarenozoum) molae

Mola mola; gill arch; Napoli (Maclaren)

Atalostrophium (Atalosparganum) sardae

Sarda sarda; gill, thyroid; Woods Hole (G. A. MacCallum)

Atalostrophium (Atalosparganum) promicrops

Promicrops guttatus; gill cavity; New York (G. A. MacCallum)

Atalostrophium (Atalosparganum) sp.

Scomber japonicus; gill cavity; Tokyo (Ishii)

Atalostrophium (Maccallozoum) epinepheli

Epinephelus striatus; gill cavity; New York (G. A. MacCallum)

Subfamily Gonapodasmiinae

Gonapodasmius haemuli

Haemulon flavolineatum; gill; New York (G. A. et W. G. MacCallum)

Gonapodasmius okushimai

Pagrosomus major; muscle; Shikoku (Okushima, Ishii)

Subfamily Didymozooinae

Didymozoum sphyraenae

Sphyraena sphyraena; mouth cavity; Napoli (Taschenberg)
Sphyraena picuda; gill; .... (Steenstrup)
Sphyraena sphyraena; mouth cavity; Genoa (Parona)
Sphyraena sphyraena; mouth cavity; Catania (Barbagallo et Drago)
Sphyraena sphyraena; gill; Portoferrajo (Parona)

Didymozoum auxis

Auxis rochei; gill lamella; Napoli (Taschenberg)

Didymozoum pretiosum

Thynnus thynnus; gill; Napoli (Ariola)

Didymozoum taenioides

Mola mola; muscle; Napoli (Rudolphi, Monticelli)
Mola mola; muscle; Belgium (van Beneden)
Mola mola; muscle; Triest (Stossich)

Didymozoum tenuicolle

Lampris luna; muscle; North Sea (Rudolphi)
Lampris luna; gill; .... (Dujardin)
Lampris luna; gill; Christiania (Lönnberg)

Didymozoum filicolle

Thunnus orientalis, Seriola quinqueradiata, Katsuwonus vagans; gill; Tokyo (Ishii)

Didymozoum longicolle

Katsuwonus vagans, Thunnus orientalis, Scomber japonicus; gill; Tokyo (Ishii)

Didymocylindrus filiformis

Katsuwonus vagans, Thunnus orientalis; gill epidermis; Tokyo (Ishii)

Didymoproblema fusiforme

Thunnus orientalis, Katsuwonus vagans; gill (interlamellar space); Tokyo (Ishii)

Lobatozoum multisacculatum

Thunnus orientalis, Katsuwonus vagans; gill epidermis; Tokyo (Ishii)

Didymocystis thynni

Thynnus thynnus; gill, gill cover; Napoli (Taschenberg)
Thynnus thynnus; gill; Triest (Stossich)
Thynnus thynnus; gill arch; Syracuse (Barbagallo et Drago)
Thynnus thynnus; gill arch; Napoli (Ariola)
Euthynnus alleteratus; gill lamella; Genoa (Parona et Perugia)
Thynnus thynnus; gill; Nice (Wagener)

Didymocystis wedli

Thynnus thynnus; gill; Nice (Wagener)
Thynnus thynnus; gill lamella; Napoli (Ariola)
Thynnus thynnus; gill lamella; Genoa (Parona)
Euthynnus alleteratus; gill lamella; Genoa (Parona)
Thunnus orientalis; gill; Tokyo (Ishii)

Didymocystis xiphiados

Xihpias gladius; gill cavity, muscle; Woods Hole (G. A. et W. G. MacCallum)

Didymocystis scomberomori

Scomberomorus maculatus; intestine; Woods Hole (Linton)
Scomberomorus maculatus; gill lamella, stomach; Atlantic (G. A. et W. G. MacCallum)

Didymocystis katsuwonicola

Scomber japonicus; gill; Japan (Kobayashi)
Katsuwonus pelamis; gill, esophagus, stomach; Misaki (Okada)
Scomber japonicus, Katsuwonus vagans, Thunnus orientalis, Seriola quinqueradiata; gill epidermis; Tokyo (Ishii)

Didymocystis semiglobularis

Thunnus orientalis, Seriola quinqueradiata; gill arch; Tokyo (Ishii)

Didymocystis ovata

Thunnus orientalis, Katsuwonus vagans; mouth cavity; Tokyo (Ishii)

Didymocystis soleiformis

Thunnus orientalis, Seriola quinqueradiata, Katsuwonus vagans; gill arch, mouth cavity; Tokyo (Ishii)

Didymocystis bilobata

Katsuwonus vagans; gill (interlamellar space); Tokyo (Ishii)

Didymocystis simplex

Katsuwonus vagans; gill epidermis; Tokyo (Ishii)

Didymocystis crassa

Thunnus orientalis; gill arch; Tokyo (Ishii)

Subfamily Köllikeriinae

Köllikeria (Köllikerizoum) filicollis

Brama rayi; gill raker; Napoli (Rudolphi)
Brama rayi; ....; Nice (Risso)
Brama rayi; gill arch, gill cavity; Napoli (Kölliker)
Brama rayi; muscle; Nice (Wagener)
Brama rayi; gill cavity; North Sea (van Beneden)
Brama rayi; ....; .... (Taschenberg)
Brama rayi; ....; Italy (Sonsino)
Brama rayi; ....; Italy (Parona)
Brama rayi; ....; Italy (Ariola)
Brama rayi; gill arch; Ireland (Johnstone)
Brama rayi; gill arch, gill; Finistère (Legendre)
Brama rayi; mouth cavity; Finistère (Legendre)

Köllikeria (Wedlia) bipartita

Seriola dumerili; head skin; Toscane (Richiardi)
Thynnus thynnus; gill arch; Triest (Wedl)
Thynnus thynnus; gill arch; Nice (Wagener)
Thynnus thynnus; gill; Napoli (Ariola)
Thynnus thynnus; gill; Triest (Odhner)
Thynnus thynnus; gill; Italy (Parona)

Köllikeria (Wedlia) reniformis

Thunnus orientalis, Katsuwonus vagans, Seriola quinqueradiata; gill raker, lateral process; Tokyo (Ishii)

Köllikeria (Wedlia) globosa

Thunnus orientalis, Katsuwonus vagans, Seriola quinqueradiata; mouth cavity, esophagus; Tokyo (Ishii)

III. Descriptions of the Species found in Japan

I will now proceed to the detailed descriptions of the eighteen didymozooid species so far found in Japan.

Nematobothrium (Benedenozoum) sabae n. sp.

Host: *Scomber japonicus*.
Habitat: Gill.

The hermaphroditic worms occur in tangled pairs in each cyst in the branchial epidermis (fig. 15). The forebody is comparatively short and is separated from the hindbody by an indistinct neck. The cyst is oval, ca. 2.0 mm by ca. 1.0 mm. The female is longer, being 13.0–23.0 mm in length and 0.111–0.127 mm in breadth.

Forebody

The forebody is not notably unequal in breadth in comparison to the hindbody. The oval muscular oral sucker is at the anterior end of the forebody, and 0.0294–0.0392 mm in length and ca. 0.0255 mm in maximum breadth. The mouth, which opens in the oral sucker, is followed by a spherical pharynx 0.014–0.028 mm in diameter, and this in turn by the esophagus. The intestinal ceca terminate ca. 0.273 mm behind the pharynx. The uterus winds forward from the hindbody to the genital aperture lying near the oral sucker. The vas deferens runs to the genital aperture (fig. 16).

Hindbody

The hindbody is very long and thread-like, with its posterior half notably more slender and terminating obtusely. The genital organs lie for the greater part in the hindbody.

Male Organs

The two elongated, lightly coiled testes ca. 0.716 mm long and 0.032–0.079 mm broad, lie along the body length immediately behind the neck. The vasa efferentia unite into the vas deferens, which proceeds forward to the male

opening at the anterior end of the forebody.

Female Organs

The elongate, thread-like winding ovary, ca. 4.6 mm long and 0.024–0.028 mm wide, begins a short distance behind the testes and extend to the shell gland at about the middle of the hindbody. The winding vitelline gland, similar in appearance to the ovary and ca. 5.3 mm long by 0.024–0.038 mm broad, begins a short distance from the hind end of the body and extends forwards to the shell gland. The oval receptaculum

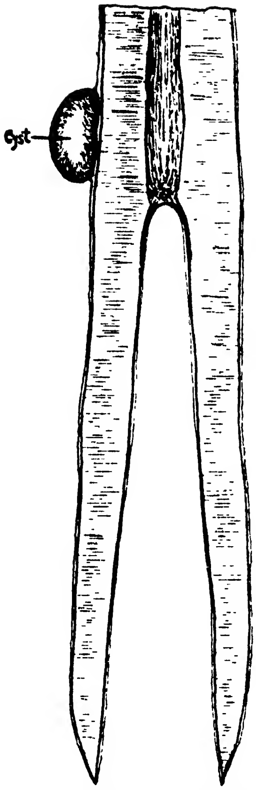

Fig. 15. Cyst of *Nematobothrium sabae* in gill epidermis.

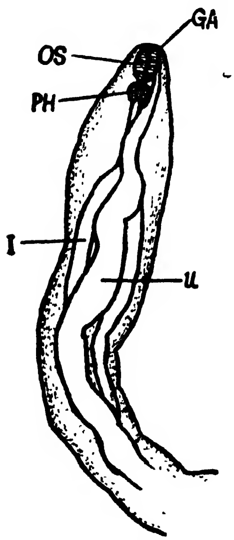

Fig. 16. Anterior end of forebody of *Nematobothrium sabae*.

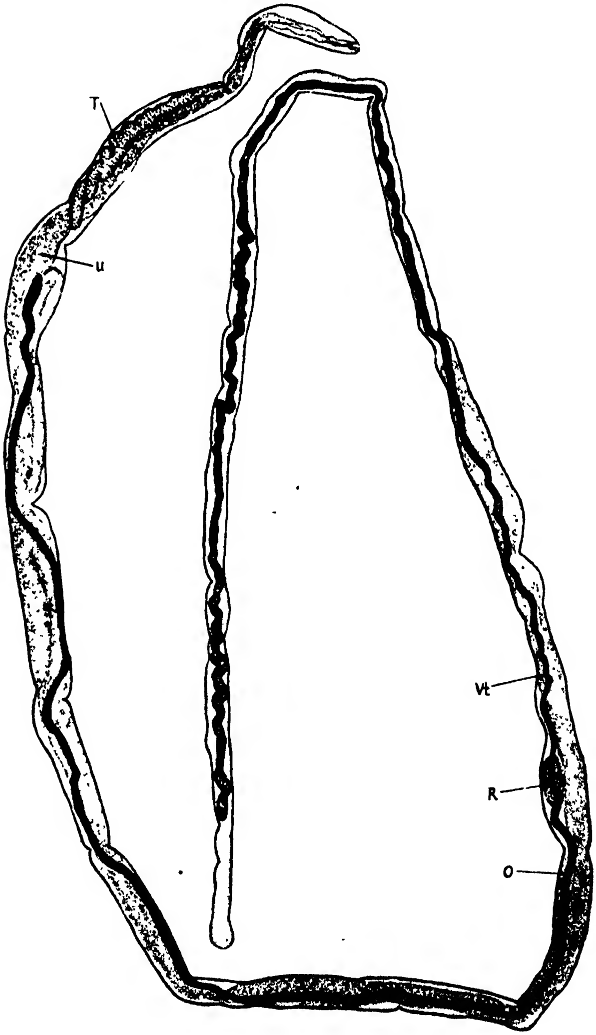

Fig. 17. *Nematobothrium sabae*; lateral view.

seminis, 0.047–0.079 mm long and 0.0376–0.0658 mm broad, lies close to the shell gland and opens into the oviduct, which is in turn connected with the vitelline duct and forms the ootype in the midst of the shell gland. The uterus, which follows the ootype, winds backward for about two thirds of the hindbody and then turns forward to the female aperture situated close to the oral sucker. The uterus is filled with innumerable, yellowish brown, broadly bean-shaped eggs, 0.016–0.017 mm long and 0.010–0.011 mm broad, which make the whole worm look the same color.

Digestive Organs

The mouth, surrounded by the oral sucker, is followed by the pharynx. The short esophagus divides into the intestinal ceca, which are unbranched and proceed straight backward along the lateral margin of the body for nearly the anterior one fifth of the hindbody.

Discussion

This species is similar to *Nematobothrium filiforme* Yamaguti, 1934, but notably differs from it in the position of the ovarian complex. Since Yamaguti's specimens are incomplete, it is not possible to make detailed comparisons of the two species.

Atalostrophium (*Atalosparganum*) sp.

Host: *Katsuwonus vagans.*
Habitat: Gill cavity.

I have obtained a very incomplete example which undoubtedly belongs to this genus and is apparently different from the species described by MacCallum. Leaving a more satisfactory description of it to the future, I will here give some notes on the specimen in my hand.

It apparently occurs single in the gill cavity. The body is elongated and ribbon-like, and ca. 0.95 mm in breadth. The circular, muscular oral sucker at the anterior end of the body is ca. 0.118 mm in diameter, and is immediately followed by a spherical pharynx ca. 0.071 mm in diameter.

The mouth surrounded by the oral sucker is followed by the pharynx and this by the esophagus, which terminates ca. 1.67 mm behind the pharynx and is surrounded by gland cells. The intestinal ceca run backwards along the margins of the body.

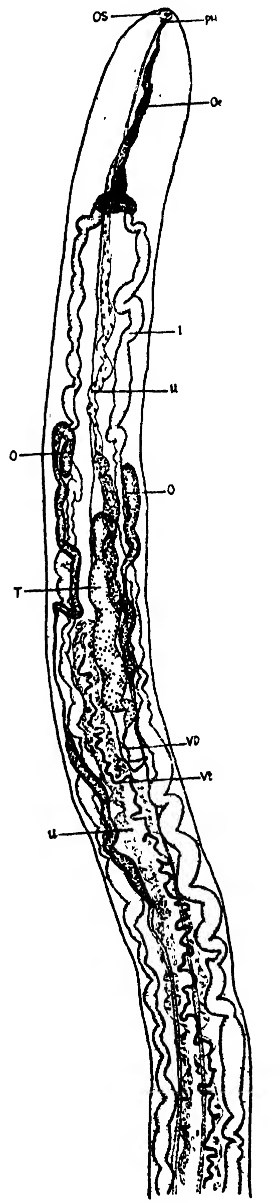

Fig. 18. Anterior part of *Atalostrophium* (*Atalosparganum*) sp.

The elongated, tubular testis, ca. 1.908 mm long and ca. 0.239 mm broad, lie ca. 4.6 mm behind the anterior end of the body. The vas deferens runs to the anterior end of the body, where it opens close to the oral sucker.

The two elongated, tubular ovaries, ca. 0.127 mm in breadth, lie along the margins of the body. The oviducts run backward from the ovaries. The elongated, thread-like vitelline gland, ca. 0.024 mm in breadth, winds in the median part of the body. The uterus runs from behind in contact with the oral sucker to the genital aperture at the anterior end of the body; it contains millions of broadly bean-shaped eggs, 0.019–0.020 mm long and 0.012–0.013 mm broad. The shell gland and the receptaculum seminis could not be seen (fig. 18).

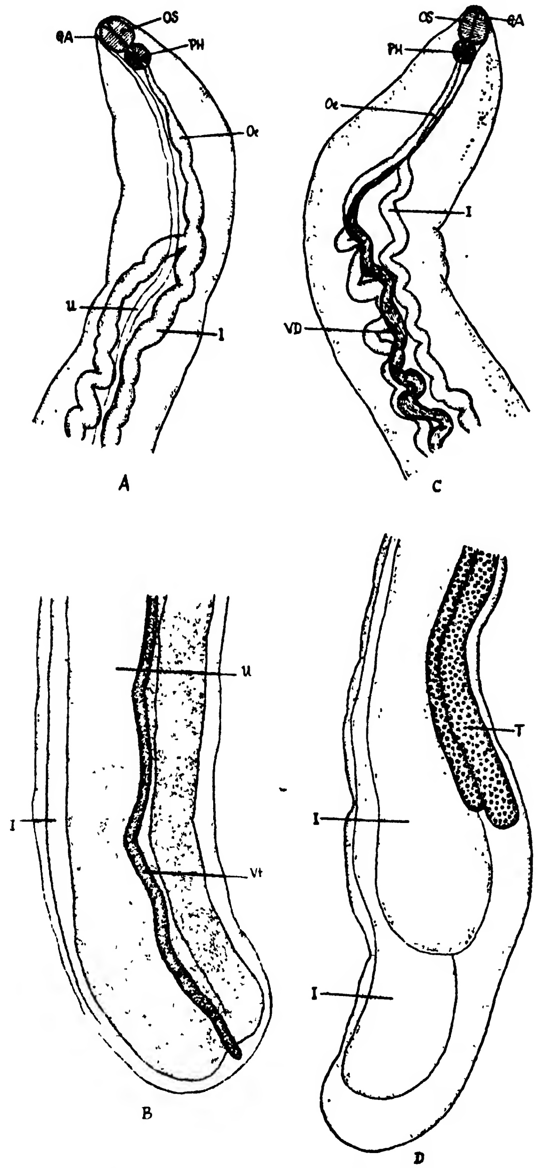

Fig. 19. *Gonapodasmius okushimai.*
A. Anterior end of female.
B. Posterior end of female.
C. Anterior end of male.
D. Posterior end of male.

Gonapodasmius okushimai n. g. n. sp.

Host: *Pagrosomus major.*
Habitat: Muscle.

Okushima found the worm living in pairs in the muscle of *Pagrosomus major*, and thought that it belonged to the Aschelminthes.

A study of the many specimens received through his kindness has enabled me to refer it to *Gonapodasmius.*

The two individuals are elongated and thread-like; the female looks yellow and the male white. The female is larger and 150–590 cm long by 0.27–0.37 mm broad; the male is 27.1–66.5 cm long and 0.21–0.3 mm broad.

Female

The terminal oral sucker, 0.079–0.094 mm long by 0.061–0.066 mm broad, is followed by the spherical pharynx 0.047–0.057 mm in diameter. The esophagus terminates 0.318–0.584 mm behind the pharynx, whence the intestinal ceca proceed to near the hind end of the body. The long, tubular, thread-like ovary, ca. 275 mm long and 0.066–0.085 mm broad, begins 38.0–59.5 mm behind the anterior end of the body. The vitellarium, similar in appearance to the ovary and ca. 250 mm long by 0.028–0.033 mm broad, begins just in front of the hind end of the body and extends forwards to the shell gland. The receptaculum seminis and shell gland lie at the distance of ca. 330 mm from the anterior end of the body. The yellowish brown eggs, 0.026 mm long by 0.016–0.017 mm broad, fill the uterus, which runs between the hind end of the body and the female aperture lying close to the oral sucker (fig. 19, A, B).

Male

The terminal oral sucker, 0.079–0.085 mm long by 0.066 mm broad, is followed by the spherical pharynx 0.042–0.052 mm in diameter. The esophagus terminates 0.35–0.47 mm behind the pharynx, whence the intestinal ceca proceed to near the posterior end of the body. The two elongate, thread-like testes, 22–50 cm long and 0.071–0.118 mm broad, are parallel to each other. The vas deferens, 15.1–26.0 mm long and 0.028–0.047 mm across, runs to the male opening lying close to the oral sucker (fig. 19, C, D).

Didymozoum filicolle n. sp.

Hosts: *Thunnus orientalis, Seriola quinqueradiata, Katsuwonus vagans.*

Habitat: Gill.

A pair in each cyst, which is elongated cylindrical and situated on the hidden side of a gill lamella (fig. 20). The cyst is 15.0–20.0 mm long and 1.0–2.0 mm broad. Each worm has the

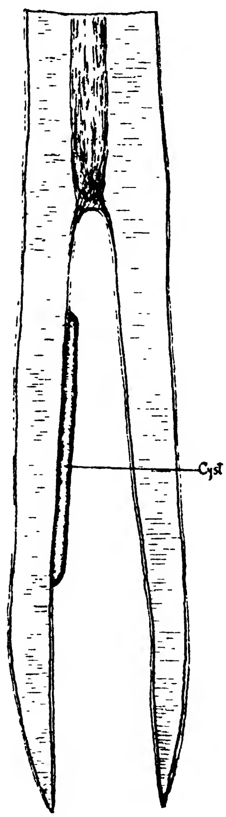

Fig. 20. Cyst of *Didymozoum filicolle*, in gill lamella.

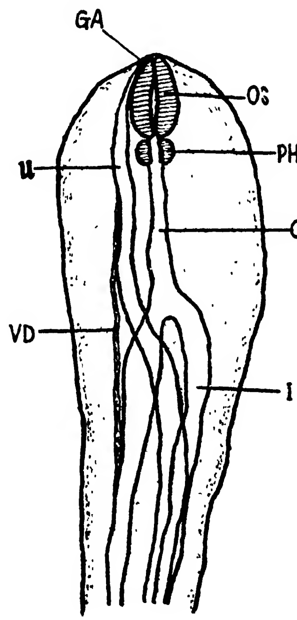

Fig. 21. Anterior end of forebody of *Didymozoum filicolle*.

hindmost third of its body bent on itself while in the cyst. One of the pair is slightly larger than the other, but both are hermaphrodites.

Forebody

The elongate, thread-like forebody, 2.0–5.0 mm long, is swollen in its anterior part, where it is 0.239–0.270 mm broad but only 0.095–0.111 mm broad in the posterior part. The circular, muscular oral sucker, 0.080–0.108 mm long and 0.047–0.071 mm broad, is at the anterior end and is followed by a spherical pharynx 0.028–0.033 mm in diameter. The esophagus terminates 0.329–0.376 mm behind the pharynx, whence the intestinal ceca run backward into the hindbody. The terminal part of the uterus issuing from the hindbody winds to the genital opening lying close to the oral sucker. The vas deferens also runs forward to the genital opening (fig. 21).

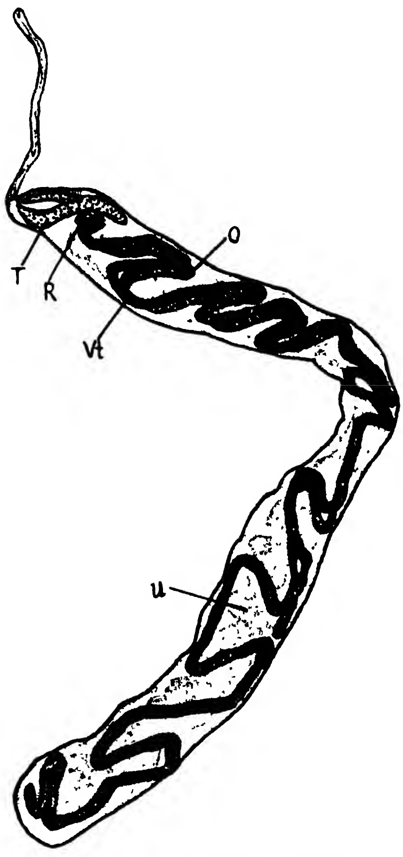

Fig. 22. *Didymozoum filiçolle*, lateral view.

Hindbody

The elongate, cylindrical hindbody is 10.0–37.0 mm long and 0.5–1.5 mm broad, and its hindmost third is bent on itself while in the cyst. The genital organs lie mostly in the hindbody, which looks yellow owing to the contained eggs (fig. 22).

Male Organs

The two elongate, more or less coiled testes, 0.071–0.080 mm broad, lie close to the anterior end of the hindbody. The vasa efferentia issuing from the testes unite into the vas deferens, which runs forwards to the genital opening at the anterior end of the forebody.

Female Organs

The elongate, thread-like, spiral ovary, 0.042–0.047 mm in breadth, lies in the anterior three fifths of the hindbody. The similarly shaped vitelline gland, 0.042–0.061 mm in breadth, extends through the whole hindbody behind the testes. The oval shell gland lies at the anterior end of the vitellarium. The vitelline duct joins the oviduct near the shell gland. The oval receptaculum seminis, 0.235–0.282 mm by 0.212–0.235 mm and lying close to the shell gland, opens into the oviduct, which is followed by the ootype lying in the shell gland. The uterus winds from near the posterior end of the hindbody to near its anterior end, and proceeds further on to the genital opening lying close to the oral sucker; it is filled with

innumerable yellow, broadly bean-shaped eggs ca. 0.016 mm by ca. 0.012 mm, which cause the whole body to look yellow.

Digestive Organs

The mouth surrounded by the oral sucker is followed by the pharynx, and this by the esophagus. The intestinal ceca wind backwards in the hindbody for four fifths of its length.

Didymozoum longicolle n. sp.

Hosts: *Katsuwonus vagans, Scomber japonicus, Thunnus orientalis.*
Habitat: Gill.

Cyst cylindrical, 3.0–5.0 mm long, 1.0–2.0 mm broad, attached to where the inner and outer gill lamellae meet; two hermaphroditic individuals in each cyst (fig. 23). Forebody elongated and thread-like, projecting from one end of the cylindrical and rather flattened hindbody; neck very sharply marked out.

Forebody

The elongated, thread-like forebody, 0.795–1.272 mm long, is swollen up at the anterior end, where it is 0.048–0.111 mm broad. The terminal, elliptical, muscular oral sucker, 0.071–0.094 mm long and 0.052–0.061 mm broad, is followed by the spherical pharynx 0.038–0.042 mm long and ca. 0.038 mm broad. The esophagus terminates ca. 0.423 mm behind the pharynx, whence the intestinal ceca proceed backward into the hindbody. The genital pore is situated close to the oral sucker (fig. 24).

Hindbody

The cylindrical, slightly flattened hindbody, 4.134–5.724 mm long and 0.429–0.716 mm broad, is folded in the cyst, and contains the greater part of the genital organs (fig. 25).

Male Organs

The two elongate testes, 0.075–0.089 mm across, lie at the anterior end of the hindbody. The two vasa efferentia unite into the vas deferens,

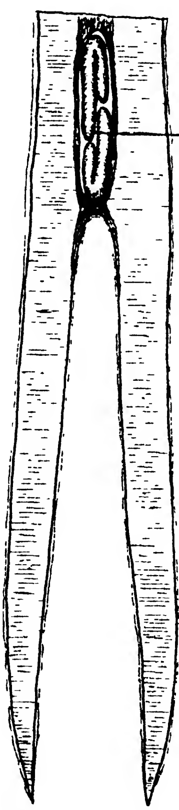

Fig. 23. Cyst of *Didymozoum longicolle*, in gill.

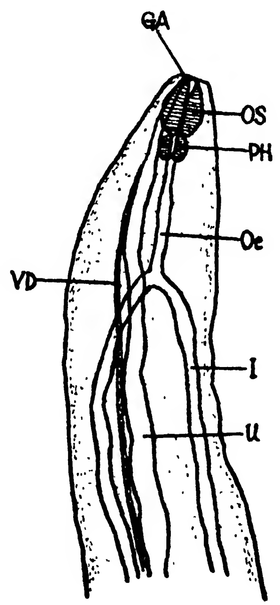

Fig. 24. Anterior end of forebody of *Didymozoum longicolle*.

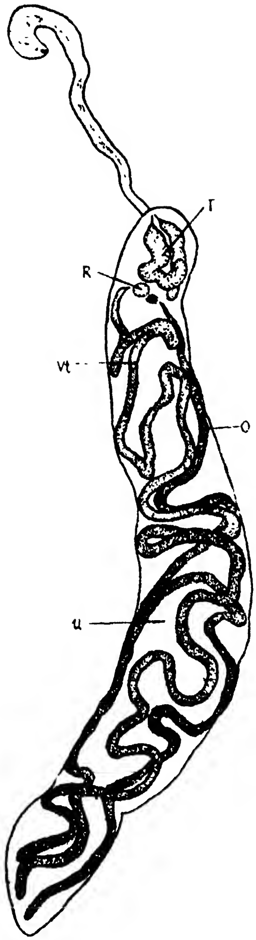

Fig. 25. *Didymozoum longicolle*, lateral view.

which proceeds to the genital opening.

Female Organs

The elongate, thread-like ovaries and vitelline glands unite near the shell gland situated behind the testes, and wind from one end of the hindbody to the other. The ovaries are 0.028–0.038 mm in breadth, and the vitelline glands 0.047–0.052 mm. The oval receptaculum seminis, ca. 0.141 mm long and ca. 0.118 mm broad, opens into the oviduct close to the shell gland. The oviduct expands into the ootype in the shell gland, whence the uterus winds to the posterior end of the hindbody, and then into the forebody, on to the genital aperture. The uterus is filled with innumerable, yellow, broadly bean-shaped eggs ca. 0.164 mm long and 0.011–0.012 mm broad. The worm looks yellowish brown owing to the contained eggs.

Digestive Organs

The ceca run through the forebody and wind on to near the posterior end of the hindbody.

Didymocylindrus filiformis n. g. n. sp.

Hosts: *Katsuwonus vagans*, *Thunnus orientalis*.

Habitat: Gill.

One pair lying straight in elongated thread-like cyst, ca. 19.0 mm by ca. 0.5 mm, in the epidermis of gill lamellae (fig. 26). Both are hermaphroditic, but one of them is a little larger than the other.

The elongated, thread-like forebody joins the much thicker and longer cylindrical hindbody at nearly the middle part of its length.

Forebody

The elongate, thread-like forebody is club-shaped at the anterior end and 2.31–2.86 mm long; its breadth at the anterior part is ca. 0.127 mm and in the posterior part 0.048–0.064 mm. The oval, muscular oral sucker at the anterior end of the forebody is 0.024–0.033 mm in diameter. The pharynx is spherical and larger than the oral sucker, being 0.038–0.047 mm in diameter. The esophagus terminates ca. 0.353 mm behind the pharynx, whence the intestinal ceca run into the hindbody. The terminal part of the uterus emerging from the hindbody winds on to the genital aperture lying close to the oral sucker. The vas deferens runs in the forebody parallel to the uterus to the genital aperture lying in contact with the oral sucker (fig. 27).

Hindbody

The elongate, thread-like, cylindrical hindbody, 15.0–18.0 mm long and 0.085–0.165 mm broad, lies straight in the cyst, and contains the greater part of the genital organs. It looks yellow owing to the contained eggs (fig. 28).

Male Organs

Two elongate testes, 0.729–1.272 mm long and 0.047–0.085 mm broad, lie in the hindbody, at the base of the forebody. The vasa efferentia unite and proceed to the genital opening lying in contact with the oral sucker at the anterior end of the forebody.

Female Organs

The shell gland is situated near one of the testes. The elongate ovaries, three in number and 0.019–0.042 mm in diameter, extend through the greater part of the length of the hindbody and unite near the shell gland. The elongate vitelline glands, 0.024–0.047 mm in diameter, lie between the ovary and the posterior margin of the hindbody and unite near the shell gland. The oval receptaculum seminis, 0.118–0.165 mm long and 0.071–0.118 mm broad, lie near the shell gland and opens into the oviduct, which is enlarged into the ootype in the shell gland. From this the uterus winds to one end of the hindbody and then to the other; its terminal part runs in the forebody to the genital opening

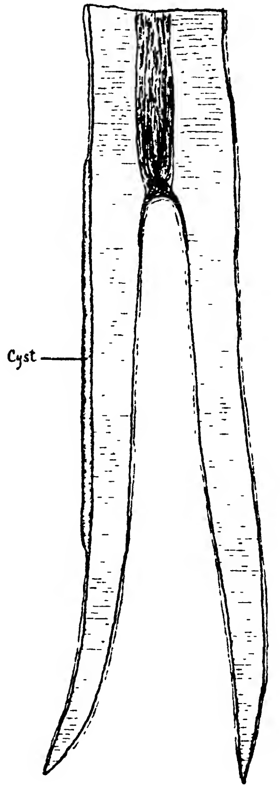

Fig. 26. Cyst of *Didymocylindrus filiformis*, in gill epidermis.

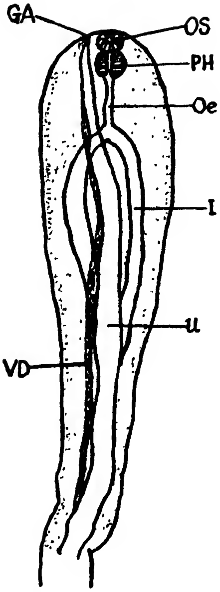

Fig. 27. Anterior end of forebody of *Didymocylindrus filiformis.*

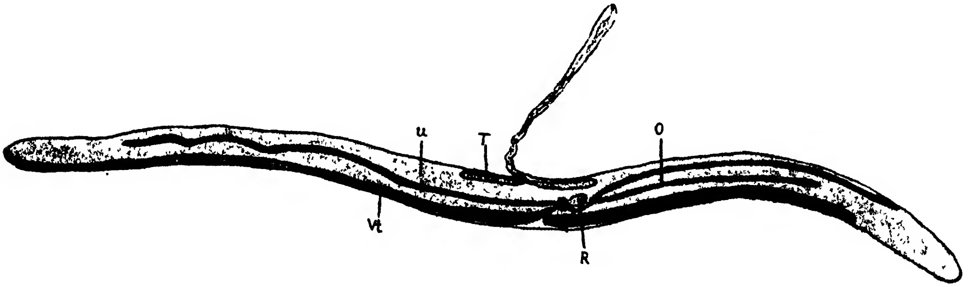

Fig. 28. *Didymocylindrus filiformis*, lateral view.

lying near the oral sucker. The whole uterus is filled with innumerable, yellow, broadly bean-shaped eggs, 0.017–0.019 mm long and ca. 0.009 mm broad.

Digestive Organs

One of the intestinal ceca runs to one end of the hindbody while the other runs to the other end.

Didymoproblema fusiforme n. g. n. sp.

Hosts: *Thunnus orientalis, Katsuwonus vagans.*
Habitat: Gill.

Cyst fusiform, ca. 10.0 mm long and ca. 2.0 mm broad, hanging on by a filiform process to the base of the free portion of the gill lamellae (fig. 29, 30).

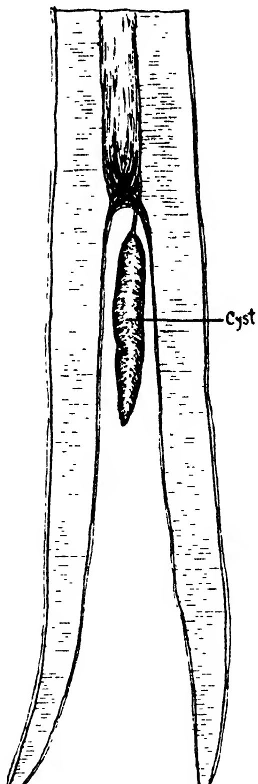

Fig. 29. Cyst of *Didymoproblema fusiforme*, in interlamellar space.

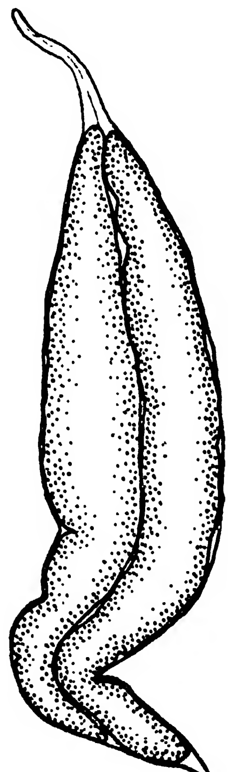

Fig. 30. Pair of *Didymoproblema fusiforme*, in cyst.

Forebody elongated and thread-like, projecting from the middle part of the fusiform hindbody.

Forebody

The elongate, thread-like forebody is only slightly enlarged at the anterior end and is 0.954–1.272 mm long and 0.039–0.064 mm broad. The oval, muscular oral sucker at the anterior end of the forebody is ca. 0.052 mm long and ca. 0.033 mm broad. The spherical pharynx, 0.024–0.028 mm in diameter, is behind the oral sucker in contact with it. The esophagus terminates ca. 0.611 mm behind the pharynx, whence the intestinal ceca run on into the hindbody. The terminal part of the uterus emerging from the hindbody winds to the genital opening lying near the oral sucker. The vas deferens runs to the genital aperture (fig. 31).

Hindbody

The fusiform hindbody is 5.0–10.0 mm long and 1.0–2.0 mm broad, and has a slender process at one end. It contains the greater part of the genital organs and looks yellow owing to the contained eggs (fig. 32).

Male Organs

An elongate testis, ca. 0.028 mm in breadth, lies in the hindbody on either

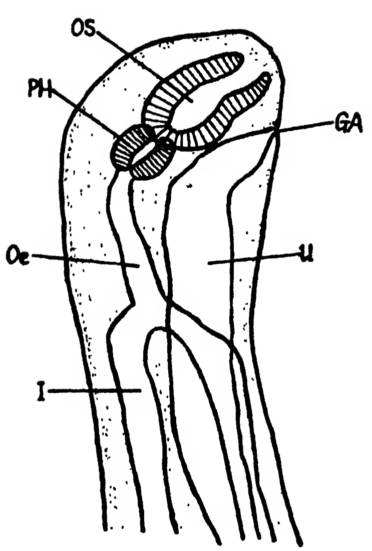

Fig. 31. Anterior end of forebody of *Didymoproblema fusiforme*.

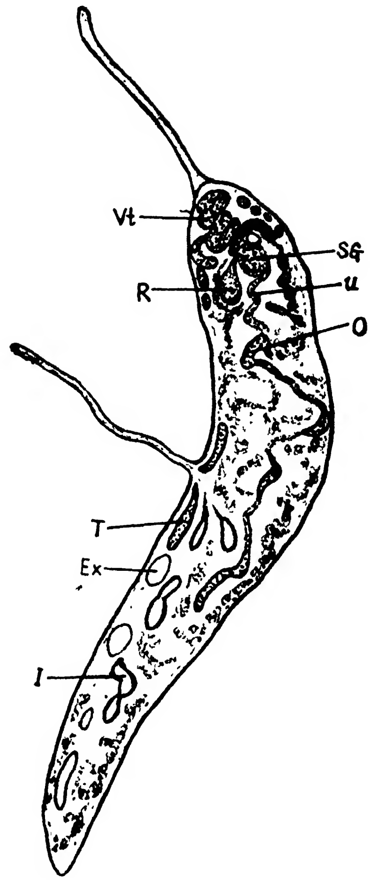

Fig. 32. Longitudinal section of *Didymoproblema fusiforme*.

side of the base of the forebody. The vasa efferentia unite into the vas deferens which proceeds to the genital opening at the anterior end of the forebody.

Female Organs

The shell gland lies at a short distance from the base of the attachment process. The elongate, thread-like, winding ovary 0.024–0.052 mm in diameter, extends from the shell gland somewhat further than the farther testis. The elongate, thread-like, coiled vitelline glands, 0.047–0.071 mm in breadth, lie mainly near the base of the attachment process and in the middle part of the hindbody. The pyriform receptaculum seminis is situated near the shell gland, and is ca. 0.141 mm long and ca. 0.103 mm broad. The oviduct is enlarged into the ootype in the shell gland, from which the uterus winds to near the opposite end of the hindbody, and further on into the forebody to the genital opening lying near the oral sucker. The innumerable yellow, broadly bean-shaped eggs, 0.017–0.019 mm by 0.010–0.012 mm, makes the body look yellow.

Digestive Organs

The mouth opening in the oral sucker is followed by the spherical pharynx, and this by the esophagus. The intestinal ceca run to the posterior end of the forebody and further on in the hindbody wind to near the end opposite the attachment process.

Lobatozoum multisacculatum n. g. n. sp.

Hosts: *Thunnus orientalis, Katsuwonus vagans.*
Habitat: Gill.

Cyst moniliform, pointed at one end, thick and rounded at the other, 13.0–20.0 mm long, 2.0–6.0 mm in maximum breadth, in epidermis of gill lamellae; two hermaphroditic individuals in each cyst. Forebody elongated and thread-like, projecting from the middle of the even side of hindbody (fig. 33, 34).

Forebody

The elongate, thread-like forebody, 2.385–3.021 mm long, is slightly swollen at the anterior end, where it is 0.095–0.143 mm broad, but only 0.039–0.048

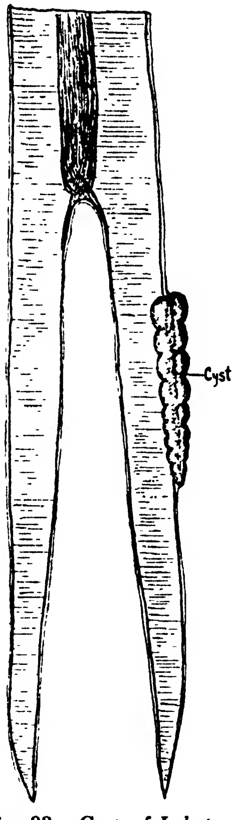

Fig. 33. Cyst of *Lobatozoum multisacculatum*, in gill epidermis.

Fig. 34. Pair of *Lobatozoum multisacculatum*, in cyst.

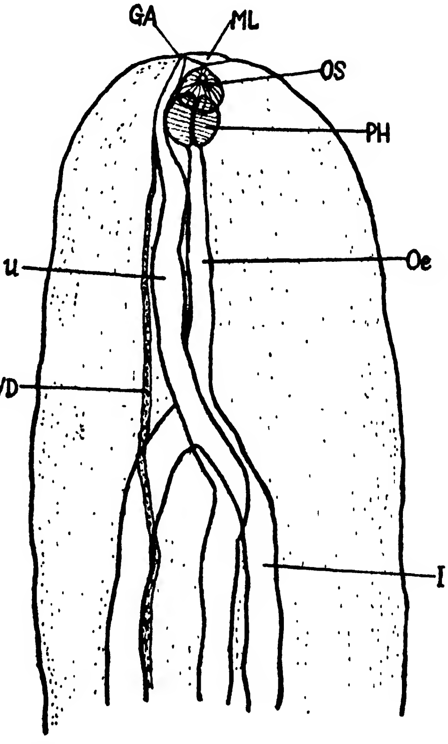

Fig. 35. Anterior end of forebody of *Lobatozoum multisacculatum*.

mm broad elsewhere. The terminal, circular, muscular oral sucker, ca. 0.019 mm in diameter, has at its anterior border, a circular lip ca. 0.027 mm in diameter, and is followed by the spherical pharynx ca. 0.027 mm in diameter. The esophagus terminates ca. 0.094 mm behind the pharynx, whence the

intestinal ceca proceed backward into the hindbody. The genital opening lies in contact with the lip (fig. 35).

Hindbody

In the natural state in the cyst, the long hindbody presents an even border on the inner side and eleven lobes on the outer; it is broad in the middle part, slender at the ends, 5.0–15.0 mm long, and contains the greater part of the genital organs (fig. 36).

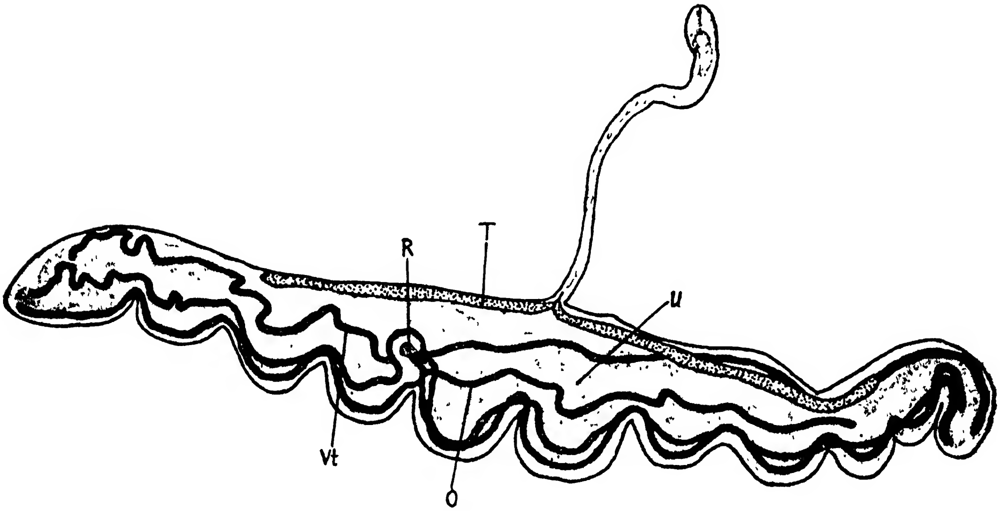

Fig. 36. *Lobatozoum multisacculatum*, lateral view.

Male Organs

The two long testes, 2.067–2.385 mm long and ca. 0.079 mm broad, lie in the hindbody one on either side of the base of the forebody. The vasa efferentia unite into the vas deferens, which proceeds to the genital opening.

Female Organs

The shell gland is situated midway between the even and lobed borders of the hindbody, almost in line with the middle of one of the testes. The three long, wavy, thread-like ovaries, 0.032–0.056 mm broad, lie close to the lobed margin of the hindbody, and unite near the shell gland. The similarly shaped, less wavy vitelline gland, 0.048–0.064 mm broad, and with four principal filaments, lie roughly parallel to the ovaries nearer to the even border of the hindbody than the corresponding ovaries. The oval receptaculum seminis, 0.141–0.254 mm long and 0.118–0.143 mm broad, lying near the shell gland opens into the oviduct, which enlarges in the shell gland into the ootype. The uterus winds back and forth from one end of the hindbody to the other and finally enters the forebody, in which it runs forward to the genital aperture. The innumerable yellow eggs are broadly bean-shaped and 0.014–0.015 mm long by 0.009–0.01 mm broad.

Digestive Organs

One of the ceca runs to one end of the hindbody while the other runs to the other end.

Didymocystis katsuwonicola (Okada, 1926)

Already dealt with in detail at the beginning.

Didymocystis semiglobularis n. sp.

Hosts: *Seriola quinqueradiata, Thunnus orientalis.*
Habitat: Gill.

Cyst globular, ca. 5.0 mm in diameter, at base of gill rakers; two hermaphroditic individuals of equal size in each cyst (fig. 37). Forebody elongate, thread-like, projecting from flattened end of semiglobular hindbody (fig. 39, 40).

Forebody

The elongate, thread-like forebody has a slight swelling near its anterior end; it is 1.11–1.27 mm long and in the anterior part 0.207–0.223 mm broad, but elsewhere only 0.085–0.111

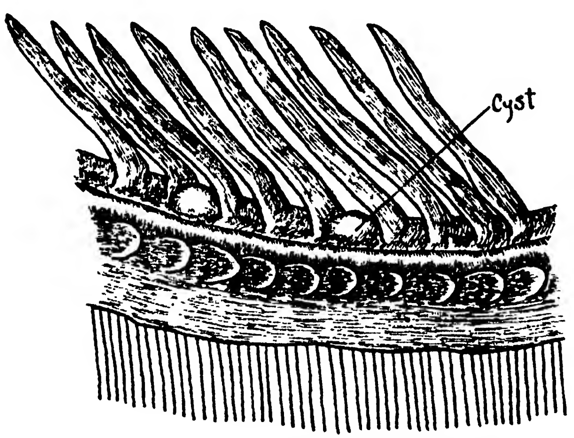

Fig. 37. Cyst of *Didymocystis semiglobularis*, in gill arch.

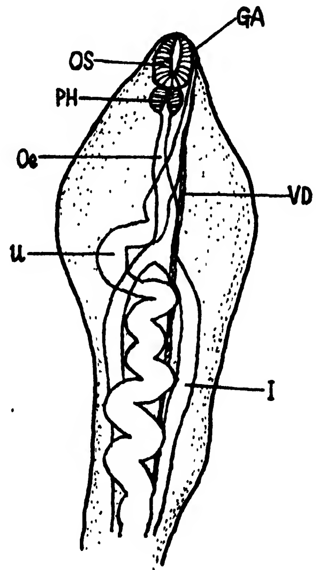

Fig. 38. Anterior end of *Didymocystis semiglobularis*.

mm broad. The terminal elliptical, muscular oral sucker is 0.061–0.075 mm long and 0.042–0.047 mm broad, and is followed by the pharynx, which is spherical and ca. 0.052 mm long and 0.047–0.052 mm broad. The esophagus terminates ca. 0.239 mm behind the pharynx, whence the ceca run backward into the hindbody. The end part of the uterus on emerging from the hindbody winds forward to the genital opening lying close to the oral sucker. The vas deferens runs straight forward to the genital opening (fig. 38).

Hindbody

The semiglobular hindbody, 2.178–3.657 mm long and 1.829–2.862 mm broad, looks yellow and contains the greater part of the genital organs. The

two individuals in a cyst are in contact with each other by the flattened side of the hindbody, so that the two together make a globe.

Male Organs

Two elongate testes, ca. 1.113 mm long and 0.038–0.141 mm broad, lie in the hindbody at the base of the forebody, one on either side. The vasa efferentia unite into the vas deferens, which proceeds to the genital opening as already described.

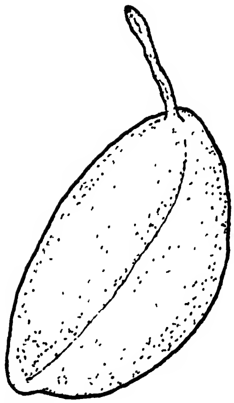

Fig. 39. Lateral view of *Didymocystis semiglobularis.*

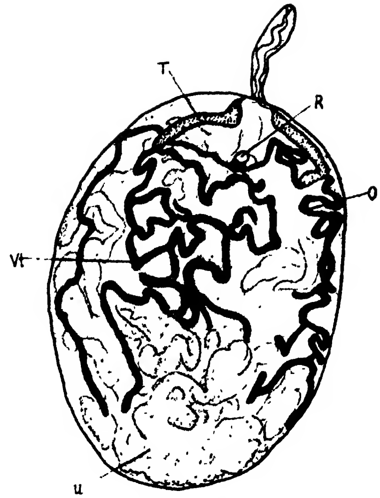

Fig. 40. Dorsoventral view of *Didymocystis semiglobularis.*

Female Organs

The long, thread-like, more or less branched ovaries, ca. 0.047 mm broad, lie close to the lateral border of the body. The long, thread-like vitelline glands, ca. 0.071 mm broad, lie in the central part of the hindbody, between the ovaries. The oval shell gland is situated between and behind the testes. The vitelline duct unites with the oviduct near the shell gland. The oval receptaculum seminis, 0.071–0.118 mm long and 0.061–0.094 mm broad, lies near the shell gland and unites with the oviduct. This is followed by the ootype, which passes through the shell gland and continues into the uterus, whose convolutions occupy the greater part of the hindbody and contain innumerable yellow, broadly bean-shaped eggs 0.016–0.019 mm long and 0.009–0.012 mm broad.

Digestive Organs

To what I have said about them in connection with the forebody, I may add that the ceca run in the lateral parts of the hindbody to near its posterior end.

Discussion

This worm is similar to *Didymocystis reniformis* Ariola in form. Ariola says that the genital pore lies immediately below the intestinal bifurcation, and the pharynx is bipartite. There is no doubt that these statements are erroneous and as Ariola's description is incomplete, I cannot refer my species to his.

Didymocystis wedli Ariola, 1903.

Host: *Thunnus orientalis.*
Habitat: Gill.

Cyst elongated oval, 2.0–3.0 mm long, 0.5–1.0 mm broad, in epidermis of

gill lamellae; two hermaphroditic individuals of almost equal size lying in each cyst like two commas forming a vortex (fig. 41). Forebody elongated and thread-like, projecting from the two-lobed anterior end of hindbody; the latter is like a mammalian stomach.

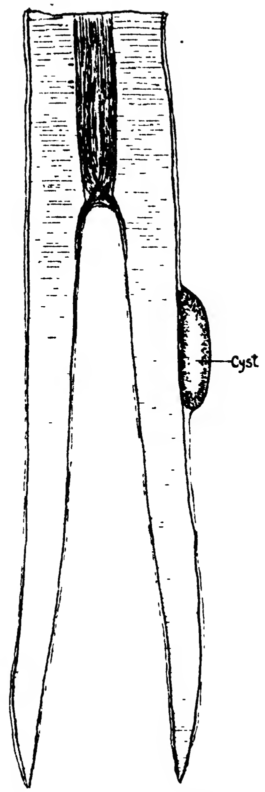

Fig. 41. Cyst of *Didymocystis wedli*. in gill epidermis.

Forebody

The elongate, thread-like forebody, ca. 0.716 mm long and 0.088–0.095 mm broad, is narrower towards the anterior end. The terminal, ellipt'cal, muscular oral sucker is 0.038–0.042 mm long and ca. 0.028 mm broad, and is followed by the spherical pharynx 0.028–0.038 mm in diameter. The esophagus terminates ca. 0.071 mm behind the pharynx, whence the ceca run backwards into the hindbody. The end part of the uterus on emerging from the hindbody winds forward to the genital opening lying near the oral sucker. The vas deferens runs nearly straight to the genital aperture (fig. 42).

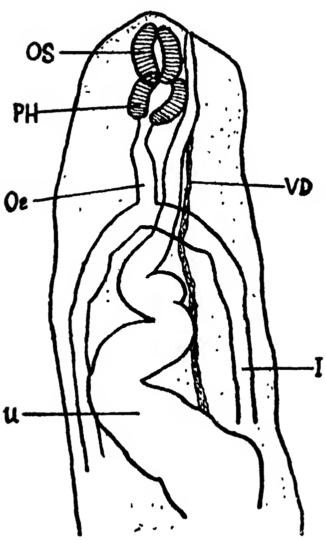

Fig. 42. Anterior end of forebody of *Didymocystis wedli.*

Hindbody

The hindbody is much swollen on either side at the anterior end where it connects with the forebody, but gradually becomes more slender towards the posterior end; it is comma-shaped, 2.07–2.62 mm long and in the anterior part 0.557–0.795 mm broad, but in the middle part 0.318–0.398 mm and in the posterior part only 0.191–0.239 mm broad (fig. 43).

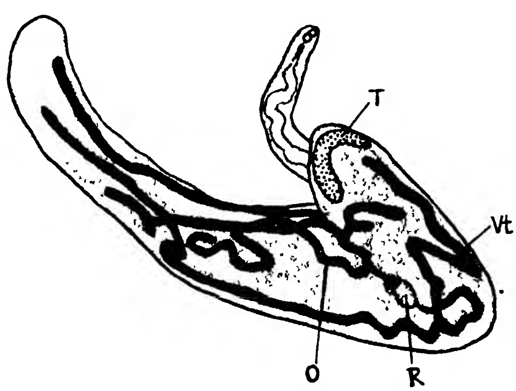

Fig. 43. *Didymocystis wedli*, lateral view.

Male Organs

The two elongate testes lie in the anterior lobes of

the hindbody. The vasa efferentia unite into the vas deferens, which proceeds with slight sinuosities to the genital opening at the front end of the forebody.

Female Organs

The elongate, thread-like, more or less coiled vitelline glands ca. 0.047 mm broad, lie at the sides of the hindbody. The shell gland lies between the vitelline glands near the center of what would be the cardiac portion of the mammalian stomach. The receptaculum seminis situated near the shell gland and ca. 0.118 mm long by ca. 0.061 mm broad, unites with the oviduct. which also receives the vitelline duct near the shell gland, and expands into the ootype in the latter. After emerging from the shell gland the uterus undergoes convolutions in the whole hindbody and finally enters the forebody to proceed to the genital aperture; it contains great many broadly bean-shaped yellow eggs 0.017–0.019 mm long and 0.011–0.012 mm broad.

Digestive Organs

It is only necessary to add that the ceca terminate about one fifth of the length of the hindbody from the posterior end.

Discussion

Examination of some specimens of this species presented by Professor L. A. Jägerskiöld of Gothenburg, Sweden, to Professor S. Goto, has convinced me that Ariola's statements, "the genital pore lies immediately below the intestinal bifurcation and the pharynx is bipartite", are erroneous.

Didymocystis soleiformis n. sp.

Hosts: *Thunnus orientalis*, *Katsuwonus vagans*, *Seriola quinqueradiata*.
Habitat: Gill.

Cyst discoidal, 1.0–2.0 mm in diameter and 0.3–0.5 mm thick, in bone tissues of gill arch and mouth cavity; two hermaphroditic individuals of almost equal size in each cyst. Forebody elongated and thread-like, projecting from between two lobes of hindbody shaped like horse-shoe.

Forebody

The elongate, thread-like forebody, 0.636–0.875 mm long and ca. 0.064 mm broad, is slightly tapered towards the anterior end. The elliptical, muscular, terminal oral sucker is 0.028–0.052 mm long and 0.024–0.038 mm in maximum breadth, and is followed by the globular pharynx 0.024–0.033 mm in diameter. The esophagus terminates 0.159 mm behind the pharynx, whence the intestinal ceca run backwards into the hindbody. The end part of the uterus on emerging from the hindbody winds forwards to the genital opening lying near the oral sucker. The vas deferens proceeds with some windings to the genital opening (fig. 44).

Hindbody

The hindbody is a thick U, with one of the arms projecting slightly above the other and forming one of the two lobes, between which the forebody is inserted; in the anterior part it is 1.59–2.23 mm and in the middle part 0.477–0.636 mm thick, the posterior end being peaked; it contains the greater part

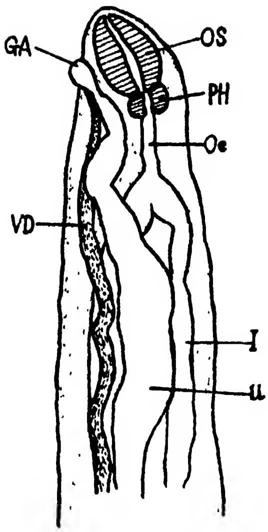

Fig. 44 Anterior end of forebody of *Didymocystis soleiformis.*

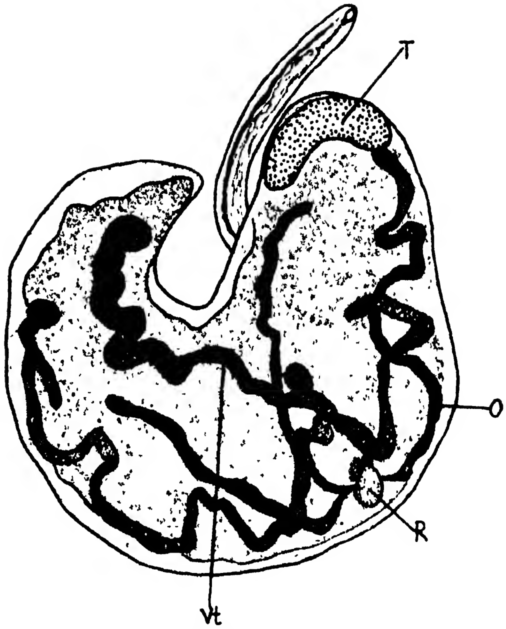

Fig. 45. *Didymocystis soleiformis*, lateral view.

of the genital organs (fig. 45).

Male Organs

The two sausage-shaped testes lie in the anterior lobes of the hindbody, and are 0.366–0.398 mm long by ca. 0.079 mm broad. The vasa efferentia unite into the vas deferens, which is ca. 0.009 mm in breadth and proceeds to the genital opening at the anterior end of the forebody.

Female Organs

The slender elongate, winding ovaries, 0.012–0.047 mm in breadth, lie in the anterior three fourths of the hindbody. The similarly shaped vitelline gland, 0.047–0.066 mm in breadth, are spread out in the hindbody. The shell gland is situated on the convex side of the hindbody about one third of its length from the anterior end. The receptaculum seminis, 0.061–0.091 mm long and 0.042–0.071 mm broad and lying near the shell gland, opens into the oviduct. The vitelline duct opens into the oviduct near the shell gland. The oviduct expands into the ootype in the shell gland and is continued into the uterus, which undergoes convolutions in the hindbody and finally enters the forebody to proceed to the genital aperture. The yellow, broadly bean-shaped eggs are ca. 0.014 mm long and ca. 0.009 mm broad.

Digestive Organs

The slightly winding intestinal ceca terminate about one fifth of the length of the hindbody from the posterior end.

Didymocystis bilobata n. sp.

Host: *Katsuwonus vagans.*
Habitat: Gill.

Cyst 2.0–3.0 mm long. 1.0–2.0 mm broad, at top of interlamellar space; two hermaphroditic individuals of almost equal size in each cyst (fig. 46). Forebody elongated and thread-like, projecting from hindbody at one third of its length from the anterior end; hindbody long oval, slightly bilobed.

Forebody

The elongate, thread-like forebody, 0.477–0.795 mm long and 0.064–0.111 mm broad, is clavate at the anterior end. The terminal, elliptical, muscular oral sucker, 0.059–0.063 mm long and 0.035–0.039 mm broad, is followed by the globular pharynx 0.039–0.049 mm in diameter. The esophagus terminates ca. 0.094 mm behind the pharynx, whence the ceca proceed backward into the hindbody. The end part of the uterus on emerging from the hindbody winds forward to the female opening lying near the oral sucker. The vas deferens runs almost straight to the male opening lying in contact with the female aperture (fig. 47).

Hindbody

The oval hindbody is 1.511–1.988 mm long and 0.875–1.034 mm broad, and contains the greater part of the genital organs, which impart their color to it (fig. 48).

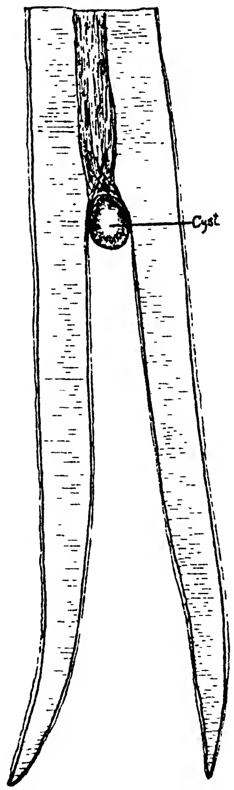

Fig. 46. Cyst of *Didymocystis bilobata*, in interlamellar space.

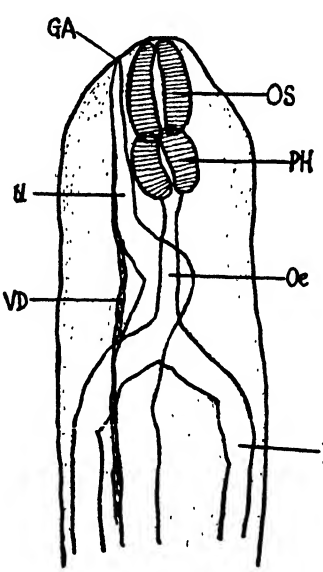

Fig. 47. Anterior end of forebody of *Didymocystis bilobata.*

Male Organs

The two elongate testes, ca. 0.635 mm long and 0.047–0.085 mm broad, lie in the hindbody contiguous to the base of the forebody. The vasa efferentia unite into the vas deferens, which proceeds forward almost straight to the genital opening.

Female Organs

The elongate, thread-like, winding ovaries lie in the hindbody, and are ca.

0.047 mm in breadth. The similarly shaped vitelline gland also lies in the hindbody, and are ca. 0.047 mm in breadth. The oval shell gland is situated a short distance back of the testes. The oval receptaculum seminis lying near the shell gland opens into the oviduct and is ca. 0.235 mm long and ca. 0.212 mm broad. The vitelline duct opens into the oviduct near the shell gland, in which lies the ootype. The uterine convolutions in the hindbody on leaving it becomes a simple winding canal, which proceeds forwards to the genital aperture lying near the oral sucker. The uterus is filled with innumerable yellow, broadly bean-shaped eggs, 0.016–0.018 mm long and 0.010–0.012 mm broad.

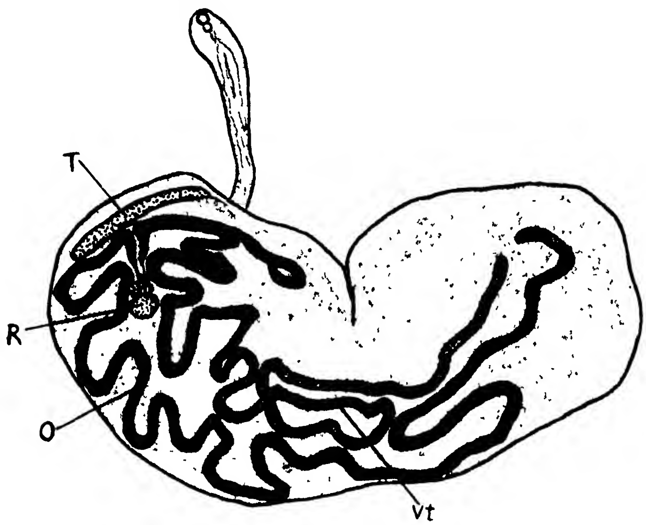

Fig. 48. *Didymocystis bilobata*, lateral view.

Digestive Organs

The slightly winding intestinal ceca proceed at first anteriad to near the testes and then backward to near the hind end of the body.

Didymocystis ovata n. sp.

Hosts: *Thunnus orientalis, Katsuwonus vagans.*

Habitat: Mouth cavity.

Cyst globular, ca. 2.5 mm in diameter, in mucous membrane of mouth cavity; two hermaphroditic individuals of almost equal size in each cyst. Forebody slender, long, projecting from side of smaller end of oval hindbody, nearer to the smaller than to the thick end.

Forebody

The elongate, thread-like forebody, 0.795–0.875 mm long and almost uniformly 0.043–0.048 mm broad, shows hardly any swelling at the anterior end. The terminal, circular, muscular oral sucker, ca. 0.028 mm in diameter, is followed by the spherical pharynx 0.019–0.024 mm in diameter. The esophagus terminates ca. 0.094 mm behind the pharynx, whence the ceca run backward into the hindbody. The end part of the uterus on emerging from the hindbody winds to the genital opening situated near the oral sucker. The vas deferens, ca. 0.009 mm wide, runs almost straight to the genital opening (fig. 49).

Hindbody

The ovate hindbody is 1.256–1.352 mm long and 0.906–1.049 mm broad and contains the greater part of the genital organs. The two individuals in a cyst are in contact by the flattened side of the hindbody (fig. 50).

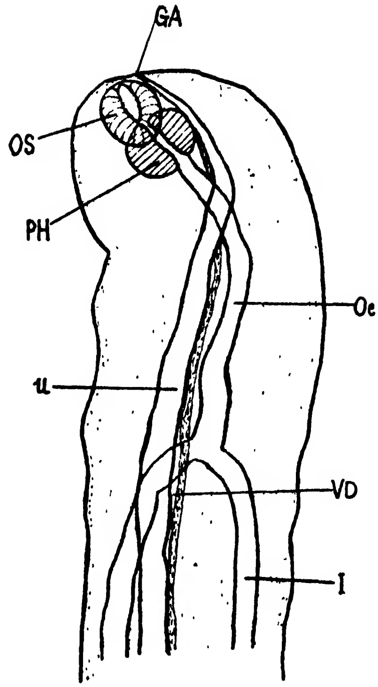

Fig. 49. Anterior end of forebody of *Didymocystis ovata.*

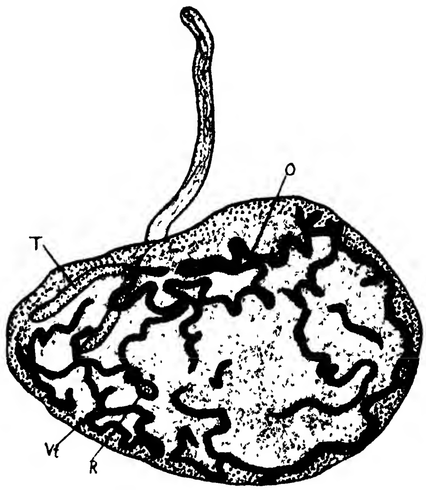

Fig. 50. *Didymocystis ovata*, lateral view.

Male Organs

The two elongate testes, 0.398–0.636 mm long and ca. 0.056 mm broad, lie in the hindbody between the base of the forebody and the small end of the hindbody. The vasa efferentia unite into the vas deferens, which proceeds to the genital opening at the anterior end of the forebody.

Female Organs

The long, thread-like, winding ovary, ca. 0.019 mm in diameter, lies near the flattened border of the hindbody and gives rise to the oviduct near the shell gland, which is situated a short distance back of the testes. The elongate, thread-like vitelline glands, ca. 0.025 mm in diameter and lying in the hindbody, unite near the shell gland and give rise to the vitelline duct, which soon opens into the oviduct. The oval receptaculum seminis, 0.108–0.188 mm long and ca. 0.071 mm broad, lying near the shell gland opens into the oviduct, which is enlarged into the ootype in the shell gland. The uterus after undergoing convolutions in the hindbody, leaves it and proceeds in the forebody to the genital aperture situated near the oral sucker. The innumerable yellow, broadly bean-shaped eggs are 0.013–0.014 mm long and 0.010–0.011 mm broad.

Digestive Organs

The intestinal ceca run in the hindbody on either side of the median line.

Didymocystis crassa n. sp.

Host: *Thunnus orientalis.*

Habitat: Gill.

Cyst spherical, ca. 3.5 mm in diameter, in periosteum of gills; two herma-

phroditic individuals of almost equal size in each cyst. Forebody elongated, thread-like, projecting from between the thick anterior lobes of hindbody, which is stout and of almost uniform thickness throughout.

Forebody

The elongate, thread-like forebody is 0.795–1.113 mm long and tapers slightly in the anterior part, where it is ca. 0.064 mm broad but only 0.079–0.095 mm broad in the posterior part. The terminal, circular, muscular oral sucker is 0.019–0.024 mm in diameter, and is followed by the globular pharynx 0.038–0.042 mm in diameter. The esophagus terminates 0.094–0.188 mm behind the pharynx, whence the ceca run backward into the hindbody. The end part of the uterus on emerging from the hindbody winds to the genital opening lying close to the oral sucker. The vas deferens also winds to the genital opening (fig. 51).

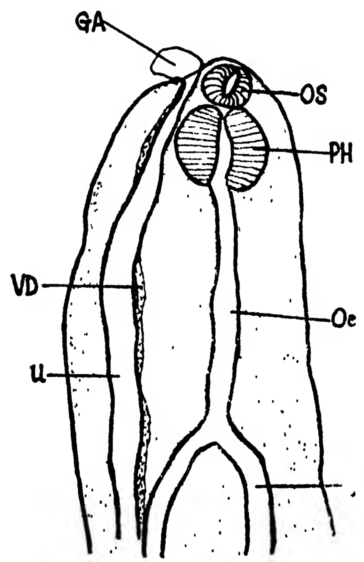

Fig. 51. Anterior end of forebody of *Didymocystis crassa*.

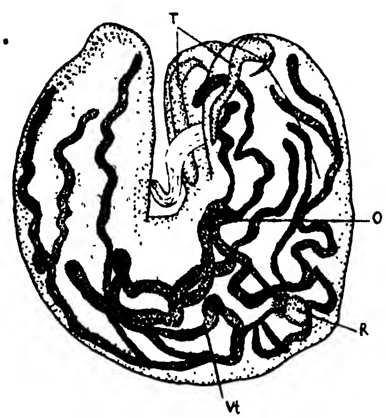

Fig. 52. *Didymocystis crassa*, lateral view.

Hindbody

The hindbody has the form of a thick U, with one of the arms deeply lobed at the anterior end and supporting the forebody; in its natural state, it is 3.98–4.21 mm long and ca. 1.113 mm broad in the anterior part but only 0.636 mm elsewhere. It contains the greater part of the genital organs (fig. 52).

Male Organs

The two testes, ca. 0.875 mm long and ca. 0.064 mm broad, lie in the anterior lobes of the hindbody already mentioned, near the base of the forebody. The vasa efferentia unite into the vas deferens which proceeds forward to the genital opening.

Female Organs

The long ovaries of the usual form, ca. 0.042 mm broad, lie in the anterior two thirds of the hindbody, including the anterior lobes. The long vitelline glands, 0.047–0.061 mm broad, extend through the whole hindbody. The oval shell gland is situated at the outer corner of the first bend of the U-shaped hindbody. The oval receptaculum seminis, 0.094–0.141 mm long by 0.079–0.118 mm broad, lying near the shell gland opens into the oviduct, which also receives the vitelline duct. The oviduct is enlarged in the

shell gland into the ootype. The uterine convolutions fill up the greater part of the hindbody, and contains large numbers of yellow, broadly bean-shaped eggs ca. 0.019 mm long and ca. 0.012 mm broad.

Digestive Organs

The ceca wind backward for four fifths of the hindbody. The other parts have been already dealt with.

Didymocystis simplex n. sp.

Host: *Katsuwonus vagans.*

Habitat: Gill.

Cyst long oval, 1.0–2.0 mm in length and 0.3–0.5 mm in breadth, in the epidermis of gill lamellae under the basal membrane; two hermaphroditic individuals of almost equal size in each cyst (fig. 53). Forebody elongated, thread-like, projecting from the middle of the long oval hindbody.

Forebody

The elongate, thread-like forebody, 0.398–0.509 mm long, is slightly enlarged at the anterior end, which is 0.048–0.064 mm broad, while elsewhere the breadth is only ca. 0.032 mm. The terminal, circular, muscular oral sucker, 0.017–0.026 mm in diameter, is followed by the globular pharynx 0.017–0.028 mm in diameter. The esophagus terminates ca. 0.094 mm behind the pharynx,

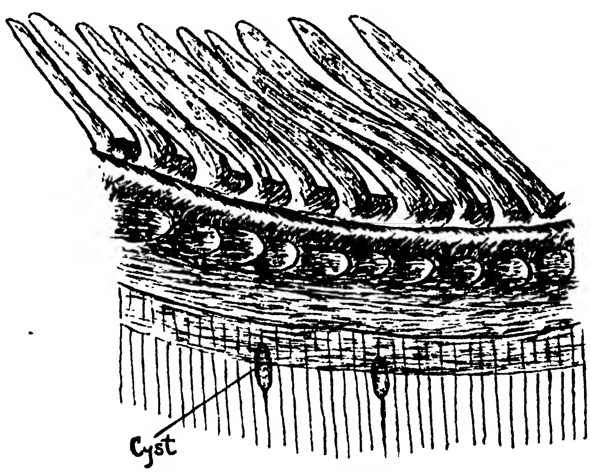

Fig. 53. Cysts of *Didymocystis simplex*, in gill epidermis.

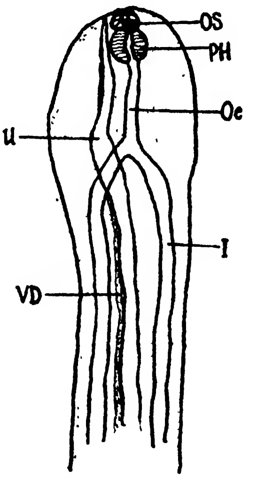

Fig. 54. Anterior end of forebody of *Didymocystis simplex*.

whence the intestinal ceca run backwards into the hindbody. The end part of the uterus on emerging from the hindbody winds to the genital opening lying close to the oral sucker. The vas deferens runs to the genital opening (fig. 54).

Hindbody

The long oval hindbody, rounded at both ends, is 0.906–1.431 mm broad

and 0.349–0.477 mm long, and contains the greater part of the genital organs. It looks yellow (fig. 55).

Male Organs

The two elongate testes, ca. 0.282 mm long and 0.033–0.042 mm broad, lie in the hindbody on one side of the base of the forebody. The vasa efferentia unite into the vas deferens, which proceeds to the genital opening.

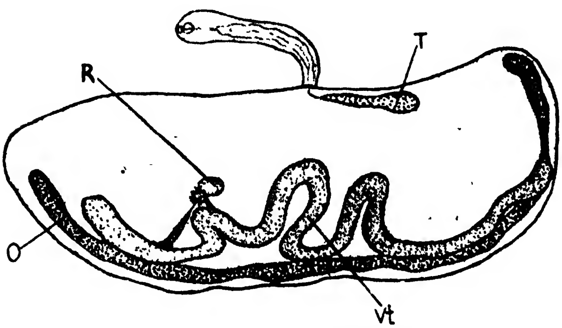

Fig. 55. *Didymocystis simplex*, lateral view.

Female Organs

The long, thread-like ovary, 0.042–0.047 mm broad, lies closely parallel to the posterior margin of the hindbody, with very little windings. The elongate, thread-like vitelline gland, with pronounced windings in its central part, lies just inside the ovary, and are 0.052–0.056 mm in breadth. The oval shell gland is situated at the hind end of the middle third of the hindbody, close to the vitelline gland. The yolk duct opens into the oviduct close to the shell gland. The oval receptaculum seminis lying near the shell gland is ca. 0.047 mm long and ca. 0.042 mm broad and connects with the oviduct, which expands in the shell gland into the ootype. The uterine convolutions fill up the greater part of the hindbody, and is filled with innumerable yellow, broadly bean-shaped eggs 0.014–0.016 mm long and ca. 0.009 mm broad.

Digestive Organs

The ceca run along the testes first towards one end and then to the other.

Köllikeria (*Wedlia*) *reniformis* n. sp.

Hosts: *Thunnus orientalis, Katsuwonus vagans, Seriola quinqueradiata.*
Habitat: Gill.

Cyst oval, 2.0–4.0 mm long and ca. 2.0–3.0 mm broad, in periosteum of gill rakers and of lateral processes of gill arch. A male and a female in each cyst (fig. 56). Forebody elongated, projecting from middle part of oval hindbody. Male much smaller than female and lodged in a hollow in hindbody of the latter.

Female

Forebody elongate, clavate, ca. 2.63 mm long, 0.48–0.89 mm broad at anterior part, projecting from the hilus of the reniform hindbody. Oral sucker circular, muscular, at anterior end of forebody, 0.282–0.477 mm in diameter. The esophagus terminates 0.127–0.239 mm behind the spherical pharynx, whence the ceca run backwards into the hindbody. The terminal part of

the uterus emerging from the hindbody winds forward to the female aperture lying near the oral sucker (fig. 57, 58).

Hindbody reniform, with a hollow in the middle part, 2.0–5.0 mm long by 2.9–3.0 mm broad. The elongate, winding, thread-like ovaries, 0.042–0.047 mm in breadth, lie in the hindbody, roughly parallel to the anterior and a lateral margin of the hindbody. The vitelline glands, similar in form but branched and anastomosed and 0.042–0.052 mm in breadth, extend through the greater part of the hindbody left vacant by the ovary and the uterus. The oval

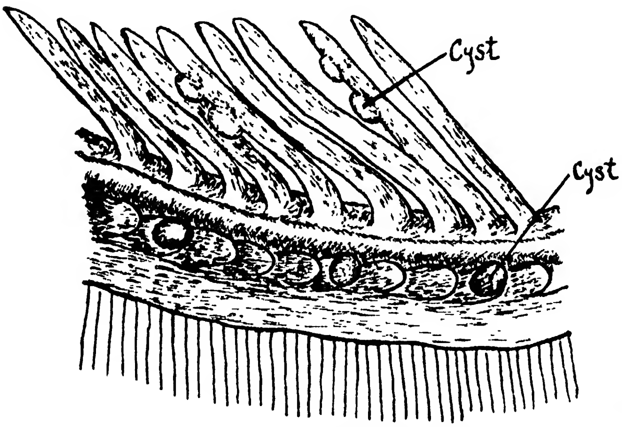

Fig. 56. Cysts of *Kollikeria* (*Wedlia*) *reniformis*, on gill rakers and lateral processes of gill arch.

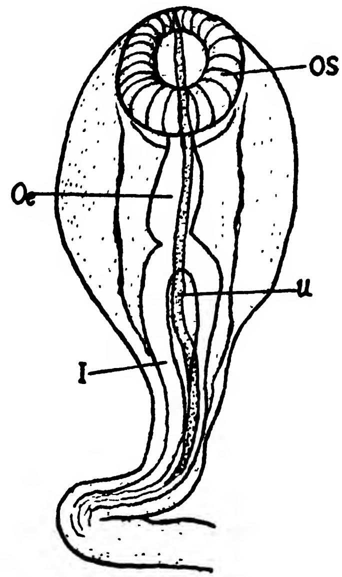

Fig. 57. Anterior end of forebody of *Köllikeria* (*Wedlia*) *reniformis*.

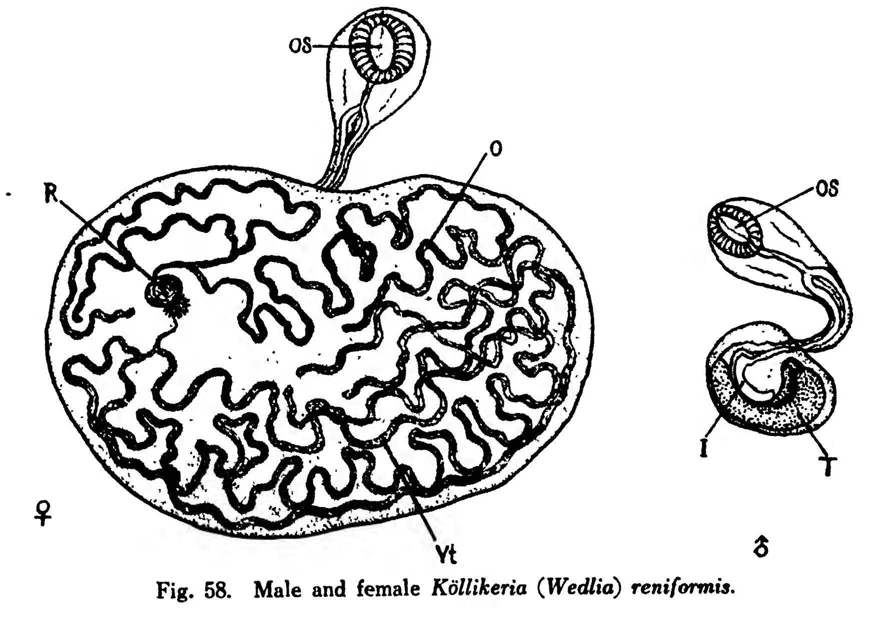

Fig. 58. Male and female *Köllikeria* (*Wedlia*) *reniformis*.

shell gland, ca. 0.306 mm long and ca. 0.188 mm broad, lie not far from the anterolateral corner of the hindbody. The oval receptaculum seminis, 0.235–0.399 mm long and 0.165–0.301 mm broad, lie close to the shell gland. The vitelline duct unites with the oviduct, which receives the duct from the receptaculum seminis. The oviduct is enlarged in the shell gland into the ootype, which continues into the uterus. The latter after winding about in the whole hindbody, enters the forebody and proceeds to the female aperture lying near the oral sucker; it is filled with great numbers of broadly bean-shaped yellow eggs, 0.027–0.03 mm long and 0.015–0.018 mm broad, which make the whole body look yellow.

Male

Forebody clavate, ca. 2.08 mm long, 0.48–0.89 mm broad at anterior part, projecting from the hilus of the reniform hindbody, which is 0.509–0.986 mm in diameter. Oral sucker 0.188–0.270 mm in diameter. Digestive organs as in the female. The two testes, 0.477–1.272 mm long and 0.159–0.165 mm broad, lie in the hindbody. The vasa efferentia unite into the vas deferens, which is 0.047–0.056 mm in diameter, and proceeds in the forebody almost straight to the male opening at the anterior end.

Discussion

Like *Wedlia bipartita* (Wedl, 1855), this species is gonochoristic, but differs from it in having no pharynx, larger receptaculum seminis and eggs, and in the absence of rudimentary ovary in the male.

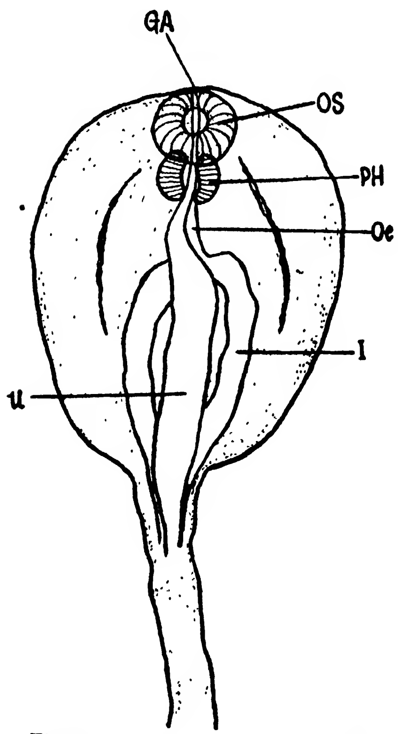

Fig. 59. Anterior end of forebody of *Köllikeria* (*Wedlia*) *globosa*.

Köllikeria (*Wedlia*) *globosa* n. sp.

Hosts: *Thunnus orientalis*, *Katsuwonus vagans*, *Seriola quinqueradiata*.

Habitat: Mouth cavity and esophagus.

Cyst globular, 2.0–5.0 mm in diameter, in the mucous membrane of the mouth and esophagus. Gonochoristic; female much larger than male, hindbody especially so.

Male

Forebody with long slender neck ca. 0.032 mm in width and pyriform head ca. 0.334 mm in width; the whole ca. 1.64 mm long. Hindbody globular, ca. 0.398 mm in diameter. The circular, muscular oral sucker, 0.127 mm in diameter, lies at the anterior end of the forebody, and is followed by the spherical pharynx ca. 0.052 mm in diameter. The esophagus terminates 0.079–0.094 mm

behind the pharynx, whence the ceca run through the narrow neck into the hindbody and terminate near its center (fig. 60).

The two elongated testes, 0.282–0.399 mm long and ca. 0.094 mm broad, occupy the greater part of the hindbody. The vasa efferentia unite into the vas deferens, which proceeds to the male opening at the anterior end of the forebody. The hindbody of the male is so closely invested by that of the female, that it is not possible to separate the two without injury to either.

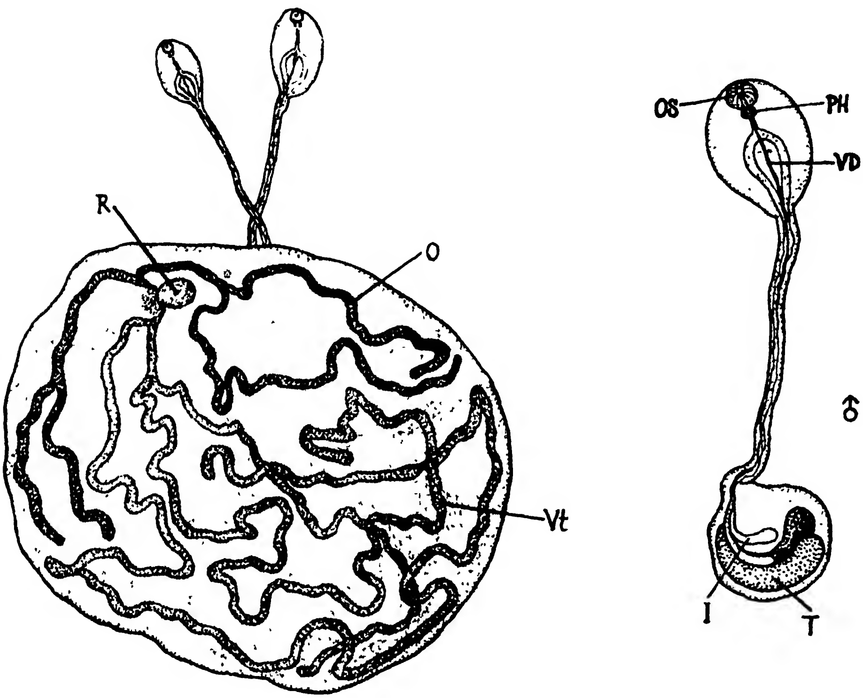

Fig. 60. Male and female *Kollikeria* (*Wedlia*) *globosa.*

Female

Forebody with a long slender neck ca. 0.064 mm in breadth and a pyriform head ca. 0.398 mm wide; the whole ca. 0.375 mm long and projecting from the middle of the anterior border of the hindbody. Hindbody globular, 1.59–1.91 mm in diameter. The circular, muscular oral sucker, 0.085–0.103 mm in diameter, lies at the anterior end of the forebody, and is followed by the spherical pharynx 0.038–0.047 mm in diameter. The esophagus terminates 0.079–0.094 mm behind the pharynx, whence the intestinal ceca run through the slender neck into the hindbody, in which they assume a transverse course. The elongated ovary, 0.028–0.056 mm in breadth, lies roughly parallel to a lateral border of the hindbody. The elongated, much divided vitelline glands, 0.042–0.056 mm in breadth, extend through the greater part of the hindbody. The oval shell gland, 0.028–0.056 mm in breadth, lies in the hindbody not far from the base of the neck. The oval receptaculum seminis, ca. 0.141 mm long

and ca. 0.118 mm broad, lies close to the shell gland. The vitelline duct unites with the oviduct, which receives the duct from the receptaculum seminis. The oviduct is enlarged in the shell gland into the ootype. The uterus winds in the whole hindbody, and emerging from it proceeds to the female aperture lying near the oral sucker; it is filled with great many yellow, broadly bean-shaped eggs 0.017–0.019 mm long and 0.010–0.012 mm broad, which make the hindbody look yellow (fig. 59, 60).

Abbreviations used in Figures

Ex	excretory canal	PH	pharynx
GA	genital atrium	R	receptaculum seminis
I	intestine	SG	shell gland
ML	mouth lip	T	testis
O	ovary	U	uterus
Oe	esophagus	VD	vas deferens
OS	oral sucker	Vt	vitellarium
Ot	ootype		

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10. Studies on the Helminth Fauna of Japan

Part 9. Nematodes of Fishes, 1

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CONTENTS

INTRODUCTION

A number of nematode parasites of Japanese fishes have been studied by Fujita and Ishii, but the greater part has remained undescribed.

In this paper I will deal with 21 genera and 37 species, of which 9 are known, 26 new and 2 undetermined. One form from *Anguilla japonica* represents a new family. The family Philometridae Baylis et Daubney, represented so far by two piscine genera, is now reinforced by four additional genera.

ASCARIDAE Baird, 1853

1. *Anisakis salaris* (Gmelin, 1790)

Syn. *Capsularia salaris* (Gmelin, 1790) Zeder, 1800
Ascaris capsularia Rud., 1802
Ascaris simplex Rud., 1804

This species has been commonly known by its larva under the name of *Ascaris capsularia* Rudolphi, but the correct specific name should be *salaris.* Since the genus *Capsularia* of Zeder is preoccupied by that of Cuvier (1798, Hydrozoa) and the larva agrees with *Anisakis* Dujardin in essential particulars, I propose the new combination *Anisakis salaris* (Gmelin, 1790). *Ascaris simplex* Rud., 1804, which is undoubtedly the adult of this species therefore becomes its synonym.

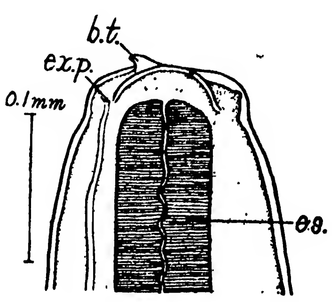

Fig. 1. Anterior extremity of larval *Anisakis salaris* (Gmelin, 1790); lateral view.

As pointed out by Baylis the larvae have conspicuous granular portion (ventriculus) between the muscular esophagus and the peculiar chyle-intestine, a ventrally directed chitinous boring tooth, the annular base of which forms the mouth opening, a spike at the tail end, and a ventral excretory pore between the two lip-like subventral projections, each bearing a small papilla and containing a flat prominence of the pulp. On the dorsal side of the head there are also two similar submedian prominences. The larvae have been found in the following marine fishes, as arranged in the order of the dates they were met with.

Host	Locality	Host	Locality
Spheroides sp.	Pacific	*Lophius litulon*	West coast of Kyûsyû
Echeneis naucrates	,,		
Caprodon schlegeli	,,	*Etrumeus micropus*	Toyama Bay
Sebastodes sp.	,,	*Sciaena albiflora*	West coast of Kyûsyû
Gymnothorax kidako	,,		
Isurus glaucus	,,	*Stereolepis ischinagi*	Toyama Bay
Trichiurus japonicus	,,	*Lateolabrax japonicus*	Inland Sea
Coryphaena hippurus	,,	*Sparus longispinis*	Toyama Bay
Sebastodes schlegeli	Mutu Bay	*Trachurus trachurus*	,,
Paralichthys olivaceus	,,	*Chirocentrus dorab*	,,
Saurida argyrophanes	Pacific	*Arctoscopus japonicus*	,,
Euthynnus pelamys	,,	*Peristedion* sp.	West coast of Kyûsyû
Salmo keta	?		
Gadus macrocephalus	Toyama Bay	*Epinephelus akaara*	Inland Sea
Thelagra chalcogramma	,,	*Parapristipoma trilineatum*	,,
Hexagrammos otakii	,,	*Scomberomorus chinensis*	,,
Scomber japonicus	,,	*Seriola quinqueradiata*	,,
Gobiid sp.	,,	*Pagrosomus unicolor*	,,

As is evident from the above table the larva parasitizes pelagic fishes more than others. This fact conforms well to the habitat of the host of the adult. *Isurus glaucus* is probably an accidental host.

According to Baylis the intestine has in all examples over 28 mm long an anterior cecum, which is short at first but grows forward until it is nearly as long as the second division of the esophagus when the body length has reached 38–40 mm. In my material, however, the worm has no intestinal cecum and is not longer than 34 mm, so that it is certain that Baylis has included two different species in *Ascaris capsularia* Rud.

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2. *Raphidascaris gigi* Fujita, 1928

The following supplementary note is based on four adult females from *Pelteobagrus nudiceps* (Sauvage).

The worm are 8.9–15.0 mm long (Fujita says 5.3 mm), and the internal organs are definitely larger than in Fujita's specimens; the esophagus may be up to 1.38 mm long (Fujita, 0.57 mm); the appendix of the ventricle is 0.48–0.63 mm long (Fujita, 0.44 mm). The subglobular, thin-shelled eggs as fixed in alcohol and measured in water are $42\text{–}51 \times 39\text{–}47\ \mu$; the ova floating within are segmented but have not reached the embryo stage.

In the body cavity of *Gnathopogon elongatus* and *Chloea castanea* I found several encapsulated female *Raphidascaris* larvae 6.2–9.4 mm long by 0.2–0.3 mm

broad. On one of the subventral lips there is a boring tooth 16 μ long and with a chitinous base. The esophagus is 0.63–0.75 mm long and the ventricular appendix up to 0.6 mm long. The nerve ring lies 0.22–0.3 mm from the head end. The vulva lies behind the appendix of the ventricle. The anus opens 0.138–0.18 mm from the sharply pointed tail end. These larvae were described by Fujita under the name of *Raphidascaris biwakoensis* n. sp., but since the boring tooth is merely a larval character and the host fishes are known to be eaten by *Pelteobagrus nudiceps*, there is no doubt that they belong to *R. gigi.*

In the same paper Fujita reported another larval *Raphidascaris* (*R. plecoglossi*) from the body cavity of several species of fishes from the same locality as *R. biwakoensis.* Unfortunately he mistook the male larva for the female, and consequently had to face insuperable difficulty in identification; I believe it also belongs to *R. gigi.*

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3. *Raphidascaris chirocentri* n. sp.

Description. One male, 9.48 × 0.4 mm, and four females, 10–29.22 × 0.85 mm, were found in the small intestine of *Chirocentrus dorab* from Toyama Bay. The cuticle is very finely striated transversely. The head is 0.12–0.23 mm

Fig. 2

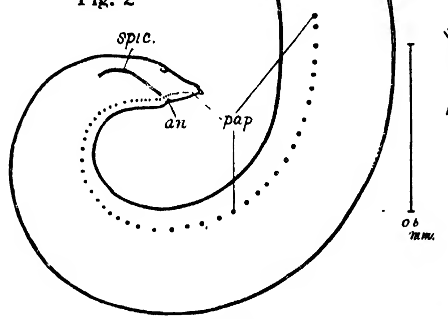

Fig. 3

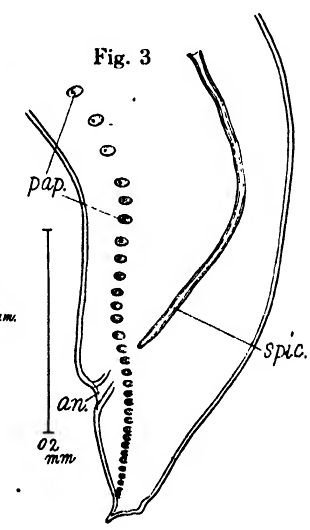

Fig. 2–3. *Raphidascaris chirocentri.*
Fig. 2. Posterior extremity of male, lateral view.
Fig. 3. Same magnified.

broad. The lips are 0.075–0.1 mm long. The neck is 0.15–0.3 mm broad. The tail is abruptly pointed and 0.12 mm long in the male but gradually attenuated, with a spinose tip and 0.35–0.53 mm long in the female. The nerve ring lies 0.32–0.48 mm from the head end. The esophagus is 1–2 mm

long by 0.18–0.3 mm broad. The ventriculus is 0.088–0.13 mm long and its appendix 0.62–0.94 mm long.

The testis extends forwards to a short distance behind the ventricular appendix. The caudal papillae, 63 on each side, are very close together and form a continuous row posteriorly, the anteriormost one lying 2.31 mm from the tail end. The two spicules are 0.315 mm long.

The muscular vagina is directed backwards from the vulva, which lies one fourth to one sixth of the body length from the head end. The roundish thick-shelled eggs with two blastomeres are 42–50 μ in diameter.

DISCUSSION. This is the first species of *Raphidascaris* ever known from marine fishes.

Raphidascaris chirocentri n. sp.

SPECIFIC DIAGNOSIS. *Raphidascaris* Raill. et Henry, 1915. Body 10–30 × 0.4–0.85 mm. Tail 0.12 mm long in male, 0.35–0.53 mm long in female. Lips 0.075–0.1 mm long. Nerve ring 0.32–0.48 mm from head end. Esophagus 1–2 mm long. Ventricular appendix 0.62–0.94 mm long. Caudal papillae in 63 pairs, very close together. Spicules 0.315 mm long. Vulva $^1/_4$–$^1/_6$ of body length from head end. Eggs 42–50 μ in diameter, 2-segmented before laying.

Habitat. Small intestine of *Chirocentrus dorab.*

Locality and date. Toyama Bay; June 19, 1928.

Type and paratypes in my collection.

I. *Raphidascaris* larvae

The female larvae characterized by the presence of a boring tooth at the mouth and a number of elongate gland cells around the anterior end of the esophagus, were found in the body cavity of *Trachurus trachurus* from the Inland Sea.

The body, 9.15–9.65 × 0.3 mm, is rounded in front and has a sharply pointed tail 0.25–0.3 mm long. The striations of the cuticle are very faintly indicated. The head is not yet distinctly trivalvate. The nerve ring lies 0.26–0.28 mm from the head end. The esophagus, ventriculus and ventricular appendix are 0.9–1.0 mm, 0.063–0.08 mm, 0.45–0.48 mm long respectively. In the smaller specimen the anterior ovary begins 2.65 mm from the tail end and the posterior 0.4 mm further in front, as shown in fig. 4. The

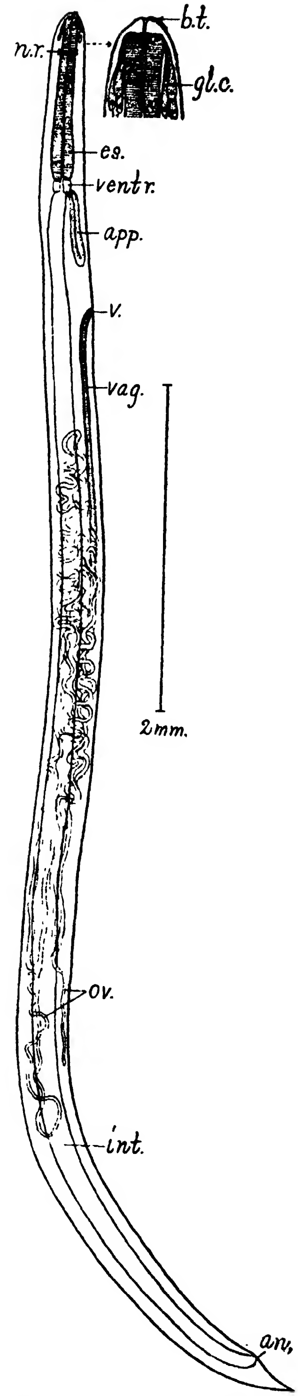

Fig. 4. Female *Raphidascaris* larva; lateral view.

vulva lies in this specimen 1.9 mm from the head end but 2.05 mm from the same point in the other.

The specific determination of this larva is not possible at present.

5. *Contracaecum incurvum* (Rud., 1819)

A number of mature males and immature females were found on March 31, 1927, in the pyloric ceca of *Xiphias gladius* Linné from the Pacific. The body, strongly curved ventrad, measures 55–84 × 0.7–1.0 mm in the male and 68–80 × 0.8–1.0 mm in the female. The cuticle is very finely striated transversely except on the ventral surface of the preanal region of the male, where numerous longitudinal rows of transversely incised cuticular elevations extend farther forward than the anterior ends of the spicules. The head is 0.3–0.37 mm broad. The lips and the interlabia are 0.2–0.28 mm and 0.1–0.12 mm long respectively. The neck, broader than the head, has a breadth of 0.29–0.425 mm. The nerve ring lies at about the level of the excretory pore, 0.75–1.0 mm from the head end. The cervical papillae are almost on the same level with the excretory pore. The esophagus is 4.5–5.5 mm long, with a maximum breadth of 0.26 mm. The ventriculus, up to 0.38 mm long, is a little longer than broad. The ventricular appendix is up to 5.3 mm long. The intestinal cecum, 3.95–5.0 mm long, terminates 1.05–1.23 mm behind the head end. The pointed, ventrally curved tail is 0.21–0.25 mm long in the male and 0.78–1.0 mm in the female.

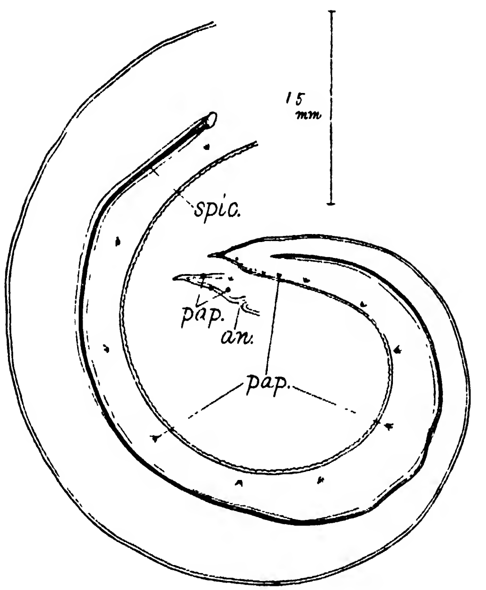

Fig. 5. Posterior extremity of male *Contracaecum incurvum* (Rud., 1819); lateral view.

There are 15 pairs of small papillae in front of the anus, the first pair lying 10.2 mm from the tail end. Of the three postanal papillae the posteriormost one is lateral. The two slender spicules with narrow alae are up to 8.75 mm long.

The vulva divides the body length in the proportion of 1 : 1.5.

6. *Contracaecum histiophori* n. sp.

Description. One immature male (24 × 0.25 mm), one immature female (25 × 0.25 mm) and one gravid female (47.6 × 1.3 mm) were found on October

19, 1929, in the intestine of *Histiophorus orientalis* from Toyama Bay.

The immature worms are almost filiform, but the gravid one is swollen at the posterior half and tapers gradually towards the ventrally curved anterior end. The tail is abruptly pointed and only 0.15 mm long in the male, but rather gradually attenuated and 0.38–0.48 mm long in the female. The cuticle is very finely striated transversely except on the ventral surface of the male, where there are numerous longitudinal rows of sharply incised cuticular ridges extending from behind the anterior end of the spicules to 0.5 mm in front of the cloaca.

MALE. The nerve ring, the excretory pore and the cervical papillae lie 0.4 mm, 0.45 mm, 0.5 mm respectively from the head end. The esophagus is 2.25 mm long by 0.1 mm broad. The ventriculus is 0.088 × 0.11 mm and its posterior appendix 2.45 mm long. The intestinal cecum, 1.625 mm long, extends to 0.85 mm from the head end. There are 16 pairs of very small papillae in the preanal region, the first pair lying 0.528 mm behind the anterior end of the spicules. Of the three postanal papillae the last one is exactly lateral. The two slender spicules are about 2.15 mm long. The transverse muscular bundles are fairly well developed on the ventral side of the preanal region.

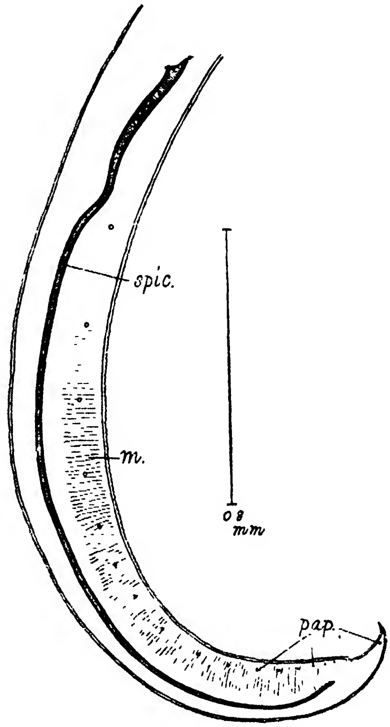

Fig. 6. Posterior extremity of male *Contracaecum histiophori*; lateral view.

FEMALE. The following measurements were made on the single gravid female: head 0.23 mm broad; lips 0.15 mm long; neck 0.2 mm broad; tail 0.475 mm long; nerve ring 0.625 mm from head end; excretory pore and cervical papillae just behind nerve ring; esophagus 3.28 × 0.21 mm; ventriculus 0.15 mm in diameter; ventricular appendix 4.0 mm long; intestinal cecum 2.5 mm long, 1.18 mm behind head end; vulva at about middle of body; uterine eggs subglobular, delicate-shelled, 60–80 μ long as fixed in alcohol and measured in water.

DISCUSSION. This species differs from the related *C. incurvum* (Rud., 1819) chiefly in the length of the body and in the positions of the nerve ring and vulva. The specific diagnosis is reserved until male adults are obtained.

7. *Contracaecum marinum* (Linné, 1767)

Syn. *Ascaris rigida* Rud., 1809

This Linnaean species, for which Rudolphi gave a brief description under the name of *Ascaris rigida*, was found on January 15, 1928, in the small intestine of *Lophius litulon* (Jordan) from Simonoseki.

The following note is based on five males 30–45 mm long by 0.5–0.6 mm broad and three females 45–73.5 mm long by 0.6–1.2 mm broad.

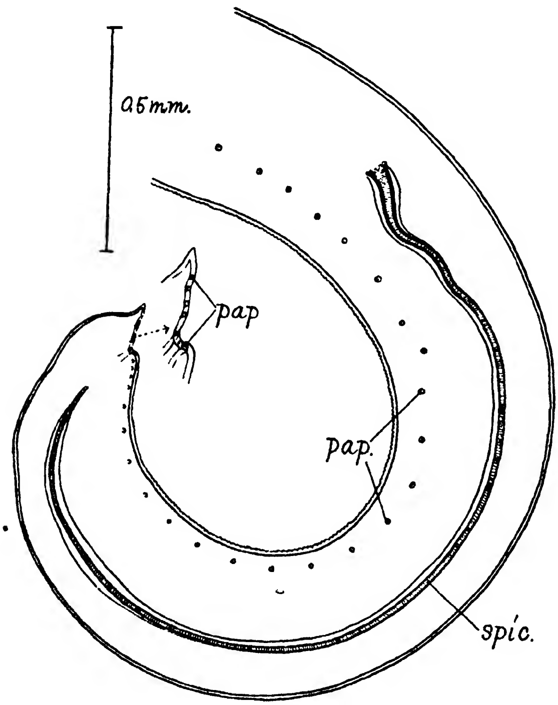

Fig. 7. Posterior extremity of male *Contracaecum marinum* (Linné, 1767); lateral view.

The cuticle is very finely striated transversely. The head is 0.175–0.28 mm broad and the neck 0.16–0.35 mm broad. The abruptly pointed tail is 0.1–0.13 mm long in the male and 0.37–0.5 mm long in the female, in which the tip bears numerous very small cuticular spines, as described and figured by Hamann. The lips, 0.13–0.28 mm long, have each two papillae. The interlabia are 0.06–0.1 mm long. The nerve ring lies 0.58–1.15 mm from the head end, and the excretory vessel opens just behind it. The esophagus is 2.8–5.8 mm long by 0.2–0.36 mm broad. The ventriculus is 0.13–0.33mm long. The intestinal cecum, 1.0–2.63 mm long, terminates 1.75–3.68 mm from the head end. The ventricular appendix is 0.8–0.88 mm long in the male.

The testis extends forwards to about 6.5–10.0 mm from the head end. There are 26 preanal, 3 adanal and 4 postanal pairs of very small papillae. The first preanal papilla lies a little in front of the anterior end of the ductus ejaculatorius. The two spicules with narrow alae are up to about 2.5 mm long.

The vulva lies 27 mm from the head end in the fully gravid specimen, while in the other immature one it lies 15 mm from the same point. The subglobular uterine eggs containing segmented ova are 42–48 × 36–42 μ.

8. *Contracaecum pagrosomi* n. sp.

DESCRIPTION. Large numbers of adults from the small intestine of *Pagrosomus unicolor* from the Inland Sea. The body, 36–38 × 0.6–0.65 mm in the male and 59–67 × 0.8–0.9 mm in the female, gradually tapers towards the head, but terminates abruptly. The cuticle has very fine transverse striations. In the male there are numerous strong muscular bundles running transversely on the ventral side of the preanal region. The head is 0.2–0.26 mm broad. The lips, 0.15–0.2 mm long, have each two papillae. The interlabia are 0.075–0.088 mm long. The neck is 0.18–0.238 mm broad. The nerve ring lies 0.67–

Fig. 8

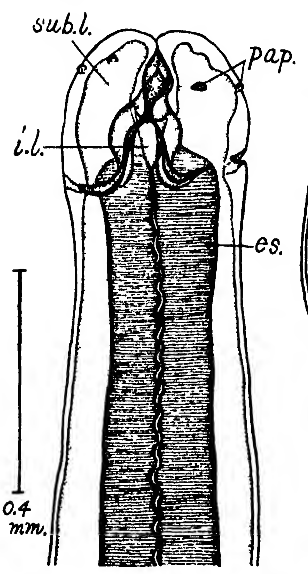

Fig. 9

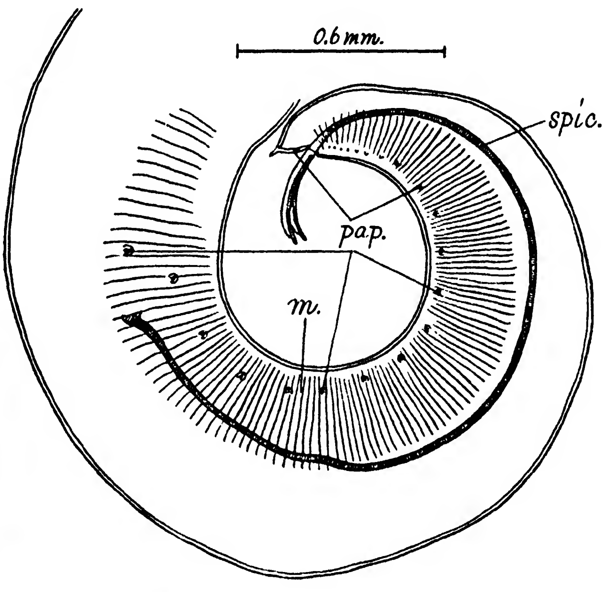

Fig. 8–9. *Contracaecum pagrosomi.*
Fig. 8. Anterior extremity of female; ventral view.
Fig. 9. Posterior extremity of male; lateral view.

0.85 mm from the head end. The excretory duct opens just behind the nerve ring.

The esophagus is 3.75–4.56 mm long. The nearly spherical ventriculus is 0.2–0.28 mm in diameter. The slender, solid ventricular appendix is 1.6–1.9 mm long. The intestinal cecum, 2.75–3.88 mm long, terminates 1.25–1.47 mm from the head end. The cone-shaped tail is 0.09–0.1 mm long in the male and 0.27–0.37 mm long in the female, in which the tip has numerous minute spine-like structures. The testis begins 1.8–4.0 mm behind the esophagus. The well developed ductus ejaculatorius is 2.0–2.3 × 0.25–0.28 mm. There are about 21 pairs of preanal papillae diminishing in size posteriorly; the first pair lies a short distance behind the beginning of the ductus ejaculatorius. Of the postanal

papillae only two pairs could be counted. The two spicules are 2.75–3.13 mm long.

The reflexed anterior end of the ovary lies 3.1–4.1 mm behind the vulva, which in turn lies 2–3 times as far from the tail end as from the head end. The vagina is directed straight backwards from the vulva; its length could not be measured accurately. The subglobular delicate-shelled uterine eggs containing two blastomeres are 48–57 μ long.

Contracaecum pagrosomi n. sp.

SPECIFIC DIAGNOSIS. *Contracaecum* Railliet et Henry, 1912; with generic characters. Body finely striated transversely, 36–38 × 0.6–0.65 mm in male, 59–67 × 0.8–0.9 mm in female. Head 0.2–0.26 mm broad. Neck 0.18–0.238 mm broad. With strong transverse muscular bundles in ventral preanal region in male. Tail abruptly pointed, 0.09–0.1 mm long in male, 0.27–0.37 mm long in female. Nerve ring 0.67–0.85 mm from head end. Esophagus 3.75–4.56 mm long. Ventriculus nearly spherical, 0.2–0.28 mm in diameter. Ventricular appendix 1.6–1.9 mm long. Intestinal cecum terminating 1.25–1.47 mm from head end. About 21 pairs of preanal papillae. Spicules 2.75–3.13 mm long. Vulva 2–3 times as far from tail end as from head end. Uterine eggs subglobular, 48–57 μ long.

Habitat. Small intestine of *Pagrosomus unicolor*.

Locality. Inland Sea; May 24, 1930.

Type and paratypes in my collection.

9. *Contracaecum gracile* n. sp.

DESCRIPTION. Two male and two female adults were found in the stomach of *Muraenesox cinereus* from the Inland Sea. They are very slender, filiform and measure 19–27 mm by 0.27–0.35 mm broad. The fine transverse striations of the cuticle are only recognizable under high magnification. The cervical papillae and the excretory pore lie just behind the nerve ring, which is 0.45–0.57 mm apart from the head end. The head is 0.1–0.16 mm broad. The lips and interlabia are 0.08–0.14 mm and 0.036–0.06 mm long respectively. The neck is 0.1–0.14 mm broad. The tail is abruptly pointed and only 0.07–0.075 mm long in the male but tapers slowly and is 0.24–0.25 mm long in the female.

The esophagus is 2.17–3.0 mm long by 0.09–0.175 mm broad. The ventriculus is small and up to 0.13 × 0.15 mm. The ventricular appendix is 1.4–1.8 mm in length. The intestinal cecum, 1.56–2.34 mm long, terminates 0.8–0.93 mm from the head end.

The testicular coils may extend further forward than the posterior end of the ventricular appendix. The anal papillae of each side are 20–22 in number, the first lying a little behind the anterior end of the ductus ejaculatorius. There are, in addition, three very small papillae just in front of the anus and three similar ones behind it; the first postanal lies a little laterally to the other two.

The slender spicules are 2.44–3.0 mm in length.

The ovary does not extend forward beyond the vulva, which lies 8.4–

9.0 mm from the head end, dividing the body length in the proportion of 1 : 1.77–2.08. The vagina is directed straight backwards from the vulva. The roundish eggs are 40–50 μ in diameter and contain unsegmented ova.

DISCUSSION. This new species may possibly be identical with *C. filiforme* (Stoss., 1904), but since Stossich's paper is not accessible to me, my species is provisional. It differs from *C. amoyensis* Hsü, 1933, from the same host species in almost every respect, but particularly in the length of the intestinal cecum.

Fig. 11 Fig. 10

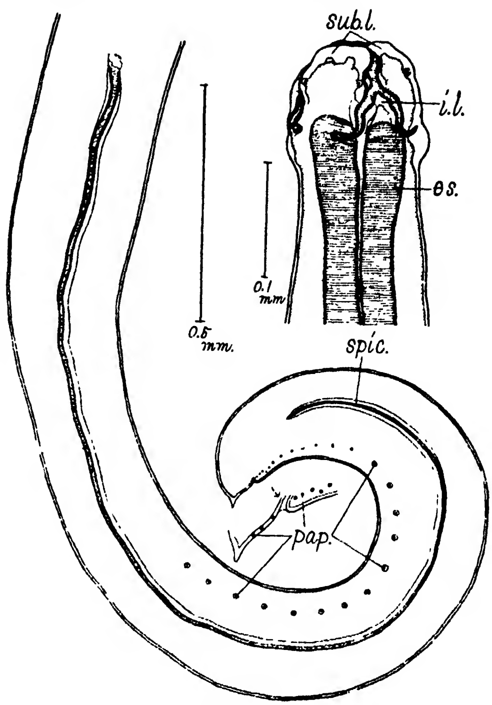

Fig. 10-11. *Contracaecum gracile*.
Fig. 10. Anterior extremity of male; ventrolateral view.
Fig. 11. Posterior extremity of male; lateral view.

Contracaecum gracile n. sp.

SPECIFIC DIAGNOSIS. *Contracaecum* Railliet et Henry, 1912; with generic characters. Body very finely striated, almost filiform, 19–27 × 0.27–0.35 mm. Head 0.1–0.16 mm broad. Lips 0.08–0.14 mm long. Interlabia 0.036–0.06 mm long. Neck 0.1–0.14 mm broad. Tail 0.07–0.075 mm long in male, 0.24–0.25 mm in female. Nerve ring 0.45–0.57 mm from head end. Esophagus 2.17–3.0 × 0.09–0.175 mm. Ventriculus up to 0.13 × 0.15 mm. Ventricular appendix 1.4–1.8 mm long. Intestinal cecum 1.56–2.34 mm long, terminating 0.8–0.93 mm from head end. 23–25 pairs of preanal papillae and 3 pairs of postanals. Spicules 2.44–3.0 mm long. Vulva dividing body length in proportion of 1:1.77–2.08. Eggs 40–50 μ in diameter; ova not segmented.

Habitat. Stomach of *Muraenesox cinereus*.
Locality and date. Inland Sea; August 11, 1931.
Type and paratypes in my collection.

10. *Contracaecum* larvae

Larvae of various *Contracaecum* species were found in the outer wall of the intestine, in the mesentery and in the body cavity of various marine fishes. They may be divided into five types as follows.

I. Larvae with Numerous Terminal Tail Spines

Host	Locality	Host	Locality
Pseudorhombus cinnamomeus	Inland Sea	*Monacanthus cirrhifer*	Inland Sea
Pleuronichthys cornutus	"	*Parapristipoma trilineatum*	"

Host	Locality	Host	Locality
Zeus faber	Inland Sea	*Conger myriaster*	Inland Sea
Trachurus trachurus	,,	*Parapercis pulchella*	,,
Chelidonichthys kumu	,,	*Sillago sihama*	Toyama Bay
Seriola quinqueradiata	,,	*Sciaena schlegeli*	,,
Saurida argyrophanes	,,	*Trichiurus japonicus*	,,
Epinephelus akaara	,,		

The body is 6.16–17.2 mm long and has numerous minute cuticular spines on the tip of the abruptly pointed tail, which is 0.1–0.21 mm long. Sometimes the worms are found enclosed in their cast-off skin with a spine at the posterior end. The lips and interlabia are distinct. The esophagus, ventricular appendix and intestinal cecum are 0.53–0.83 mm, 0.43–1.2 mm and 0.11–0.31 mm long respectively. The vulva divides the body length in the proportion of 1 : 1.1–1.45. In a specimen 20.2 mm long from *Psenopsis anomala* it lies just in front of the middle of the body.

II. Larvae with Seven Terminal Tail Spines

Host	Locality	Host	Locality
Cypselurus agoo	Mutu Bay	*Chelidonichthys kumu*	Tomioka (Kyûsyû)
Hyporhamphus sajori	Inland Sea		
Trachurus trachurus	Toyama Bay	*Stromateoides argenteus*	Inland Sea

The body is 5.5–13.3 mm long. The lips are not well differentiated. The tail, 0.13–0.18 mm long, has at its end seven short, rather blunt spines arranged in a circle. The esophagus is 0.54–1.1 mm, the ventricular appendix 0.4–0.82 mm, and the intestinal cecum 0.08–0.13 mm, long. The genital anlagen are not recognizable.

III. Larvae with a Single very Small Terminal Tail Spine

Host	Locality	Host	Locality
Spheroides sp.	Pacific	*Epinephelus akaara*	Inland Sea
Lophius litulon	,,	*Seriola quinqueradiata*	,,

The body measures 6.6–10.9 mm in length. The three lips are rudimentary. The tail, 0.15–0.23 mm long, has a very minute spine at its pointed end. The esophagus is 0.55–0.88 mm, the ventricular appendix 0.65–0.9 mm, and the intestinal cecum 0.09–0.23 mm, long. The genital anlagen are present. The vulva divides the body length approximately in the ratio of 1 : 1.6–1.7.

IV. Larvae with Boring Tooth and moderately Long Ventricular Appendix

The worms of this and the next type are easily distinguished from those of the three foregoing types by the possession of a chitinous boring tooth at the mouth and by the unarmed tail.

The body is up to 9.0 mm long. There are no true lips. In a specimen 7.6 mm long from *Spheroides* sp. (Inland Sea; Aug. 13, 1931) the intestinal cecum is 0.6 mm long, while in the largest specimen from *Ditrema temmincki* (Ise Bay; April 24, 1929) it is 0.225 mm long. The esophagus, the ventricular

appendix and the tail are 0.6–1.05 mm, 0.93–1.0 mm and 0.1 mm long respectively. The genital anlagen are present.

V. Larvae with Boring Tooth and exceedingly Long Ventricular Appendix

The larvae of this type were found in *Epinephelus akaara* from the Inland Sea and in *Branchiostegus japonicus* from the Sea of Japan. The body is 10.8–16.5 mm long and has a simple conical tail 0.13–0.18 mm long. The esophagus is 0.75–1.15 mm, the ventricular appendix 3.3–4.5 mm, and the intestinal cecum 0.1–0.25 mm, long.

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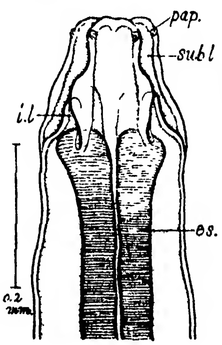
Rudolphi, C. A. Entozoorum, sive vermium intestinalium historia naturalis, Vol. 2, P. 1, 1809, p. 181.

11. *Paranisakis lophii* n. sp.

DESCRIPTION. Large numbers of adults were found in the stomach and intestine of *Lophius litulon* from the Pacific coast of Mie Prefecture. The

Fig. 13

Fig. 12



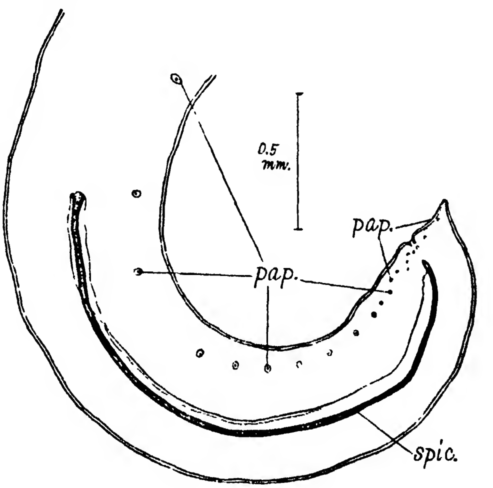


Fig. 12–13. *Paranisakis lophii*.
Fig. 12. Anterior extremity of female; dorsal view.
Fig. 13. Posterior extremity of male; lateral view.

body is 29–40 × 0.32–0.41 mm in the male and 40–45 × 0.5–0.6 mm in the female. The head tapers a little toward the anterior end, where it is 0.1–0.15 mm broad. The lips, longer than broad, are 0.15–0.2 mm long and the

interlabia 0.06–0.088 mm long. The two papillae of the dorsal lip are similar and very prominent, while those of each subventral lip are unequal in size, the more ventral one being the larger. The neck is 0.13–0.2 mm broad. The tail of the male tapers rapidly and is 0.18–0.3 mm long, while that of the female is 0.31–0.38 mm long and has inconspicuous spinelets on the tip. The transverse striations of the cuticle are recognizable only under high maginification. The ventral surface of the preanal region is striated at intervals of 18–36 μ but not longitudinally ribbed. The cervical papillae and the excretory pore lie at the same level, 0.7–0.76 mm from the head end, and the nerve ring lies a little in front of them. The muscular esophagus is 5.88–7.4 mm long by 0.15–0.25 mm broad. The almost spherical ventriculus is 0.16–0.2 mm in diameter. On either side of the rectum there is a large gland cell.

The anterior end of the testis is 8 mm behind the esophagus. There are 12 pairs of large preanal papillae, the first lying about 3.0 mm from the tail end. In addition there are on either side very small papillae, 7 in front of the anus and 4 behind it; the second postanal as numbered from behind lies very close to the median line. The alate spicules are up to 2.45 mm long. There is no accessory piece as observed by Baylis in *Paranisakis squatinae.*

The coils of the ovary do not extend farther forward than the vulva, which lies about half as far from the head end as from the tail end. The well developed vagina is directed straight backward from the vulva. The roundish uterine eggs are 48–60 × 45–54 μ; the ova are not segmented.

DISCUSSION. This species is distinguished from the closely related *P. taeniurae* Thwaite, 1927, by the shape of the lips, by the host, etc. The lateral alae of Thwaite's species must have been produced by postmortem change of the cuticle. If Baylis be correct in his statement that the excretory pore lies in front of the nerve ring and the spicules have a true accessory piece, my worm and probably also Thwaite's species should not be assigned to Baylis' genus.

Paranisakis lophii n. sp.

SPECIFIC DIAGNOSIS. Male 29–40 × 0.32–0.41 mm; female 40–45 × 0.5–0.6 mm. Head 0.1–0.15 mm broad at somewhat attenuated front end. Tail 0.18–0.3 mm long in male, 0.31–0.38 mm long in female. Esophagus 5.88–7.4 × 0.15–0.25 mm. Ventriculus almost spherical, 0.16–0.2 mm in diameter. With 19 pairs of preanal and 4 pairs of postanal papillae. Spicules up to 2.45 mm long, without accessory piece. Vulva lying about half as far from head end as from tail end. Eggs roundish, 48–60 × 45–54 µ; ova not segmented.

Habitat. Stomach and intestine of *Lophius litulon* (Jordan).

Locality and date. Pacific coast; April 3, 1927.

Type and paratypes in my collection.

12. *Paranisakis muraenesocis* n. sp.

DESCRIPTION. One male, 39 × 0.9 mm, and two female adults, 78–81 × 1.0–1.5 mm, from the stomach of *Muraenesox cinereus* from the Inland Sea.

The body is robust, broader posteriorly; cuticle thick, with very fine trans-

verse striations. The relatively short head is 0.25–0.35 mm broad at the middle. The lips are 0.25–0.35 mm long and the interlabia up to 0.13 mm long. The neck is 0.25–0.4 mm broad. The conical tail, 0.25 mm long in the male and 0.55–0.8 mm in the female, has very small cuticular spines on the tip. The nerve ring lies 0.58–0.85 mm from the head end and the excretory pore just behind it. The esophagus is 2.25–4.0 mm long by 0.35–0.4 mm broad. The spherical ventriculus is 0.26–0.37 mm in diameter.

The testis begins about 13.8 mm behind the esophagus. At some distance in front of the anus there are on either side 8 large papillae, one close behind another, and the anteriormost lying 1.31 mm from the tail end. There are, in

Fig. 14

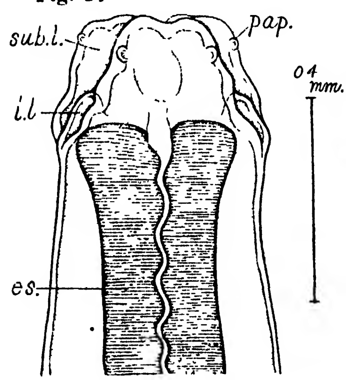


Fig. 15

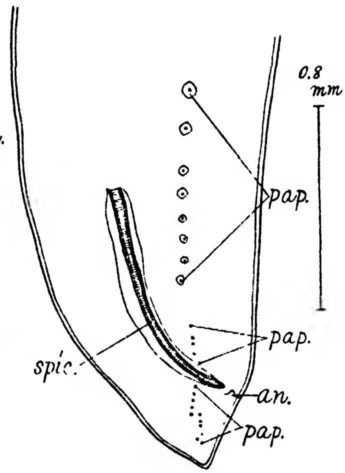


Fig. 14–15. *Paranisakis muraenesocis*.
Fig. 14. Anterior extremity of female; dorsal view.
Fig. 15. Posterior extremity of male; lateral view.

addition, 5 pairs of very small preanal papillae forming a straight row and 11 pairs of likewise small postanal papillae in a zigzag row. The alate spicules are about 0.85 mm in length. There is no accessory piece.

The anterior end of the ovarian coils lies about 7.0 mm behind the vulva in the largest specimen. The uterus and vagina are very wide. The vulva lies just in front of the middle of the body. The oval immature uterine eggs are up to $45 \times 39\ \mu$.

Discussion. This species differs from the preceding in the size of the body, in the characters of the head, caudal papillae and spicules, in the position of the vulva, etc.

The specific diagnosis is reserved until additional specimens come to hand.

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PHILOMETRIDAE Baylis et Daubney, 1926

Philometra parasiluri n. sp.

DESCRIPTION. A number of female adults of this species were found in the orbit of ***Parasilurus asotus*** (Linné) and the body cavity of ***Mogurnda obscura*** (Temm. et Schleg.) from Lake Ogura.

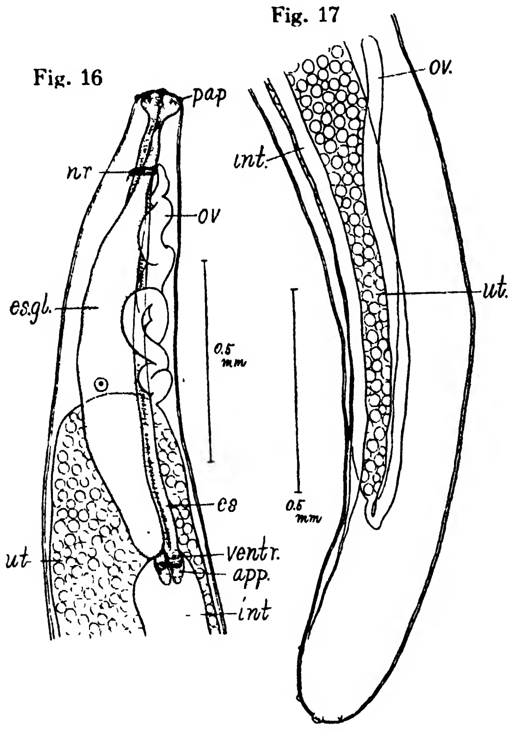

Fig. 16–17. *Philometra parasiluri.*
Fig. 16. Anterior extremity of female; lateral view.
Fig. 17. Posterior extremity of female; lateral view.

The filiform body is up to 34 mm long and 0.5 mm broad. Around the nearly truncate head end there are 8 large broad-based papillae arranged at equal intervals in the same frontal plane. At the blunt posterior extremity of the body there are two very conspicuous papillae 21–27 μ broad. Some inconspicuous additional cuticular papillae are present on one side along the entire length of the body. The cone-shaped anterior muscular part of the esophagus is 75–96 μ broad and its three anterior lobes project a little out of the mouth opening, which is 24–27 μ broad; the cylindrical, slender posterior part is 1.0–1.4 mm long and its dorsal gland is greatly developed. Between the esophagus and the intestine there is a small, muscular ventriculus, from the posterior end of which a lobed glandular appendix projects into the lumen of the intestine. The latter tapers posteriorly into a solid column attached to the wall of the tail end. There is no anus.

The cylindrical, reflexed anterior and posterior ovaries are sometimes convoluted; in the specimen whose anterior end is shown in fig. 16, the twisted ovary is directed anteriad and reaches to the nerve ring lying about 0.12–0.2 mm from the head end. The uterus terminates at both ends at variable distances from the body extremities in accordance with the degree of its development; its anterior end lies 0.27–1.1 mm from the head end and its

posterior 0.34–0.8 mm from the tail end; the contained larvae are 0.36–0.38 mm long by 9–12 μ broad. The vulva is lacking.

The males have not been found.

DISCUSSION. In 1916 Ishii described a similar nematode from the orbit of *Anguilla japonica* under the name of *Filaria anguillae.* He hesitated in assigning it to *Filaria*, because it resembled *Ichthyonema* in having neither anus nor vulva. Since there is no doubt that he overlooked the esophageal gland, it should be referred to *Philometra* Costa, 1845. My worm differs distinctly from Ishii's species, inasmuch as it has constantly 8 head papillae arranged at equal intervals in the same frontal plane, while Ishii's species has only 6 papillae, two of which are lateral and the others, two each on the dorsal and ventral sides, close behind the former.

Philometra parasiluri n. sp.

SPECIFIC DIAGNOSIS. *Philometra* Costa, 1845; with generic characters.* Female up to 34 mm long and 0.5 mm broad. With 8 head and 2 tail papillae. Swollen anterior part of esophagus 75–96 μ broad, cylindrical posterior 1.0–1.4 mm long. Esophageal gland well developed. Embryos 0.36–0.38 mm long by 9–12 μ broad. Male unknown.

Habitat. Orbit of *Parasilurus asotus* (Linné) (type host) and body cavity of *Mogurnda obscura* (Temm. et Schleg.).

Locality and dates. Lake Ogura; June 5, 1932 (type date); May 5, 1932.

Type and paratypes in my collection.

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Yorke W. and Maplestone, P. A. The nematode parasites of vertebrates, p. 442–443. London, 1926.

Zur Strassen. *Filaria medinensis* und *Ichthyonema.* Verh. Deutsch. Zool. Ges., 17. Jahresversamml., 1907, p. 110-129.

14. *Philometra opsalichthydis* n. sp.

DESCRIPTION. Several adult but not yet fully gravid females were found in the body cavity of *Opsalichthys uncirostris* (Temm. et Schleg.) and *Zacco platypus* (Temm. et Schleg.) from Lake Biwa. The specimens from the former host are up to 35 mm in length and 0.5 mm in breadth. The head papillae, 8 in number, are relatively flat and 18–24 μ broad at the base. The two prominent tail papillae are 24–36 μ in diameter. The mouth opening is 33–36 μ broad. The swollen anterior muscular part of the esophagus is 90–111 μ broad, and its three prominent anterior lobes project slightly out of the mouth; the cylindrical posterior part is 0.83–1.32 mm long and granular in appearance. The

*Baylis and Daubney defined the genus more adequately than Yorke and Maplestone, but they all overlooked the ventriculus and its appendix.

dorsal esophageal gland begins behind the nerve ring. The muscular ventriculus and its appendix are present. The intestine terminates as usual in a solid string attached to the ventral side of the body, near its posterior end. The nerve ring lies 0.22–0.25 mm behind the head end.

The cylindrical, reflexed ovaries at both ends of the body are very variable in position; the anterior begins usually in front of the uterus which lies 0.37–0.7mm from the head end, but may begin farther behind, with its proximal end directed backwards or forwards; the posterior may extend to near the tail end or begin in front of the posterior end of the uterus lying 0.43–0.66mm from the tail end. The embryo could not be observed.

A single gravid female from *Zacco platypus* is 43 mm long by 0.53 mm broad. The uterus reaching to near the body ends contains numerous fully developed embryos, which are 0.39–0.42 mm long by 9–12 μ broad and have a long, very fine tail.

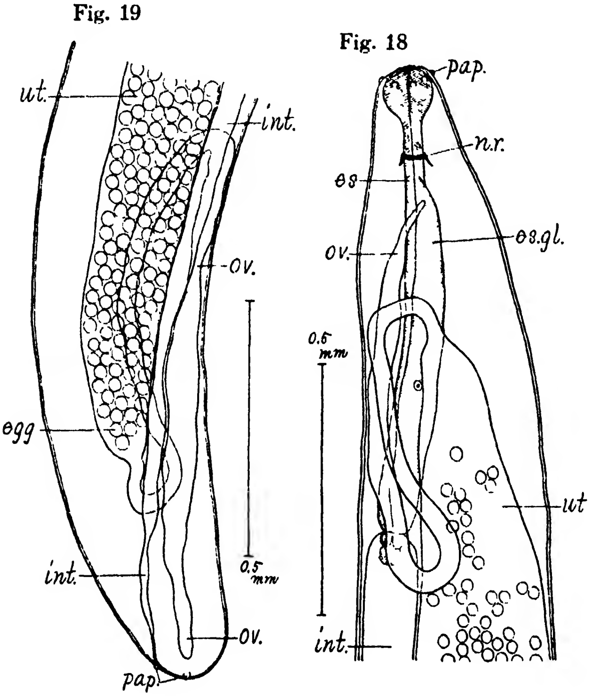

Fig. 18–19. *Philometra opsalichthydis.*
Fig. 18. Anterior extremity of female; lateral view.
Fig. 19. Posterior extremity of female; lateral view.

The male is unknown.

Discussion. This species differs from the closely related *P. parasiluri* mihi chiefly in that the cylindrical posterior part of the esophagus is glandular except only for its anterior portion and that the dorsal esophageal gland begins behind the nerve ring.

Philometra opsalichthydis n. sp.

Specific Diagnosis. *Philometra* Costa, 1845. Females up to 43×0.53 mm. Head papillae 8, flat, 18–24 μ broad at base. Tail papillae prominent, 24–36 μ in diameter. Swollen anterior part of esophagus 90–132 μ broad, cylindrical posterior 0.83–1.32 mm long. Dorsal esophageal gland beginning behind nerve ring. Embryos 0.39–0.42 mm long by 9–12 μ broad, with a long, very fine tail.

Habitat. Body cavity of *Opsalichthys uncirostris* (Temm. et Schleg.) (type host) and *Zacco platypus* (Temm. et Schleg.).

Locality and date. Lake Biwa; July 10, 1927.

Type and paratypes in my collection.

15. *Philometroides seriolae* (Ishii, 1931) n. g.

DESCRIPTION. This species was very inadequately described by Ishii under the provisional name of *Filaria seriolae.* The largest entire specimen at my disposal is 38 cm in length and 1.7 mm in maximum breadth (up to 510 ×

Fig. 20

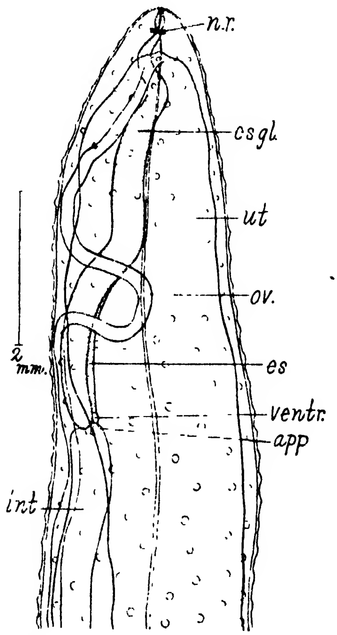

Fig. 21

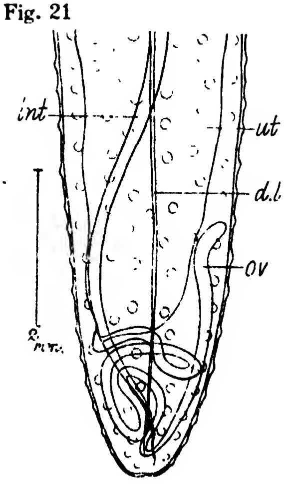

Fig. 22

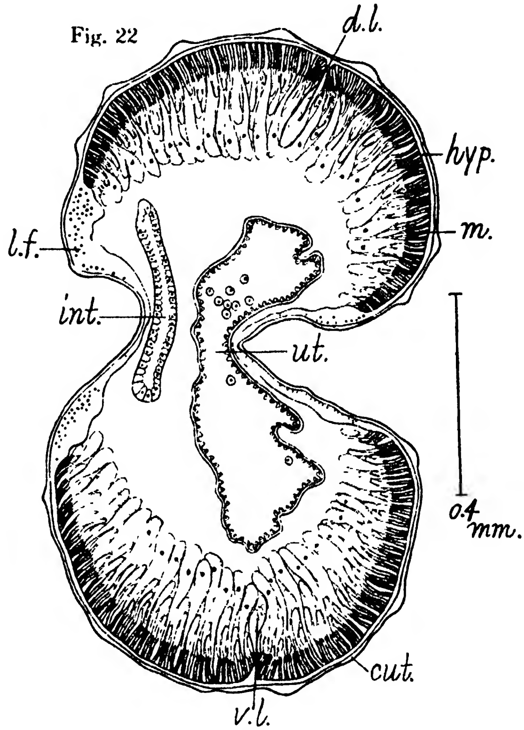

Fig. 20–22. *Philometroides seriolae* (Ishii, 1931).
Fig. 20 Anterior extremity of female; dorsal view.
Fig. 21. Posterior extremity of female; dorsal view.
Fig. 22. Cross section of female.

3 mm according to Ishii). The body is almost uniformly broad and bluntly pointed at the extremities and the relatively thick cuticle has numerous irregularly scattered, flat papilliform protuberances giving rise to a conspicuous bossy

appearance. The parietal muscle cells are strongly developed, particularly on the dorsal and ventral sides; their peripheral contractile part is laminate and stains deeply with eosin. The two granular median lines are very narrow in dorsoventral view but elongate in transverse sections. The flat, very broad lateral fields consist of a finely fibrous ground substance containing numerous nuclei.

The mouth is simple and leads directly into the slightly swollen, cylindrical anterior muscular part of the esophagus, 4.6 mm* long and with a greatly developed dorsal gland, which is 3.6 mm long by 0.4 mm broad and begins at about the level of the nerve ring, 0.4 mm from the head end. A muscular ventriculus and a small glandular esophageal appendix project into the intestine. The cuboid intestinal epithelium contains numerous fine granules and compact nuclei lying nearer to the surface than to the base; posteriorly it becomes taller as the intestine tapers, so that the lumen becomes gradually narrower and finally disappears and the intestine becomes a solid cord attached to the body wall at the tail end.

The long slender, partly coiled ovary lies at each end of the body, with its proximal end directed toward each other; it leads imperceptibly into the germiduct, which opens into the uterus at its extremity. The convolutions of the ovary and its duct are variable according to individuals. The voluminous uterus lined by cylindrical epithelium and filled with embryos reaches to near the extremities of the body. The embryo, up to 0.6 mm long, have a long, very fine tail. The vagina and vulva are absent.

The male is unknown.

DISCUSSION. This worm is very closely related to *Philometra* Costa, but differs from it in the presence of cuticular bosses all over the body surface and in the strongly developed parietal muscles.

Ishii's description may be insufficient to justify priority from a rigorous nomenclatural point of view, but I have retained his species in his honor.

Philometroides n. g.

GENERIC DIAGNOSIS. Philometridae Baylis et Daubney, 1926. Philometrinae. Body cylindrical, long, with bluntly pointed extremities and numerous prominent cuticular bosses all over. Parietal muscle cells strongly developed on dorsal and ventral sides, with conspicuously laminated peripheral zone. No head or tail papillae. Mouth simple. Esophagus somewhat swollen in front, with a well developed dorsal esophageal gland, a muscular ventriculus and a glandular appendix projecting into intestine. Intestine, ovary, uterus and embryos of *Philometra* type. Viviparous. Male unknown. Parasitic in marine fishes.

Genotype. *Philometroides seriolae* (Ishii, 1931).

LITERATURE CITED

Ishii, S. Parasites of Japanese fishes. "Biology" edited by Iwanami, Part 18, 1931, p. 207. (Japanese.)

* The measurements here given are from a fragmentary specimen.

16. *Ichthyofilaria dasycotti* n. g. n. sp.

DESCRIPTION. Only two female adults, 30.43 × 0.5 mm and 38 × 0.8 mm respectively, were found in the vicinity of the heart of *Dasycottus setiger* from Toyama Bay. The cylindrical body tapers rapidly toward the head but rather slowly toward the tail end. The head papillae which are probably present could not be definitely made out. There are no tail papillae. The somewhat oblique nerve ring lies 0.18–0.246 mm from the head end.

Fig 23

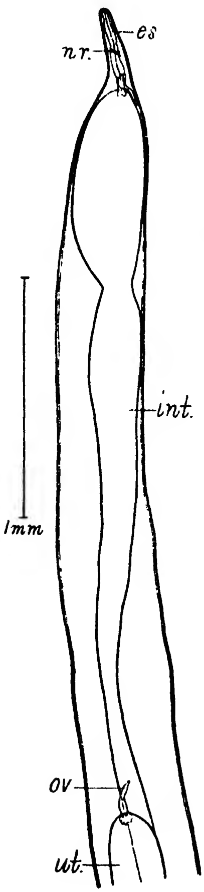

Fig. 25

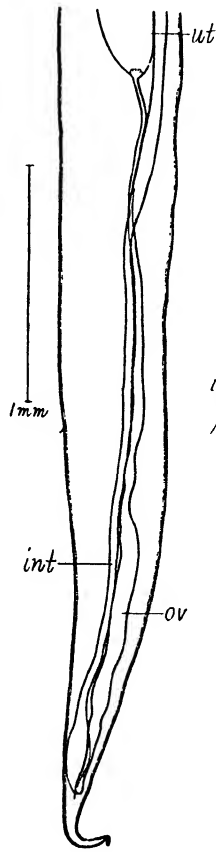

Fig. 24

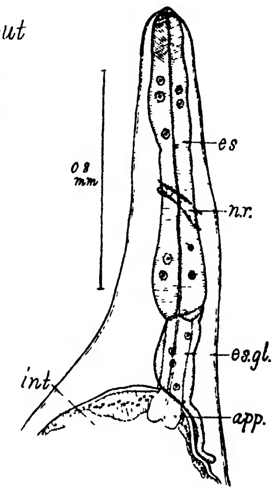

Fig. 23–25. *Ichthyofilaria dasycotti.*
Fig. 23. Anterior extremity of female; dorsal view.
Fig. 24. Same magnified.
Fig. 25. Posterior extremity of female; lateral view.

The mouth is simple. The esophagus is divided into an anterior muscular and a shorter posterior part; the former, 0.29–0.348 mm long, has two swellings which are separated from each other by the nerve ring and may be somewhat variable in breadth (0.12–0.18 mm) according to the degree of contraction; the latter is narrower and has a small glandular appendix projecting into the intestine. At the junction of these two parts is attached a long vermiform gland, which contains a small number of nuclei and extends backwards to

terminate on the anterior end of the intestine, where the epithelium is taller than elsewhere. The intestine is irregularly wide and contains brownish amorphous ingesta; in the type it tapers posteriorly into a narrow, non-functional tube lined by a single layer of flat epithelium and terminating in a fusiform swelling near the tail end, while in the paratype its posterior end turns back on itself and terminates 1.3 mm from the tail tip.

The anterior ovary is atrophied into a vermicular appendix 0.15 mm long. The cylindrical posterior ovary of the type, 2.94* × 0.09 mm, begins about 0.36 mm from the tail tip and proceeds straight forwards along the non-functional part of the intestine mentioned above, while that of the paratype, about 1.0 mm long by 0.144 mm broad, is drawn up to the posterior end of the uterus, so that the germiduct, which is narrower than the ovary, is folded between the ovary and the uterus. The very wide tubular uterus begins 3.31 mm from the head end and terminates 3.35 mm from the tail end in the type; the contained embryos are very slender, measuring 150–160 × 3 μ. There is no vagina or vulva.

DISCUSSION. Though the male is unknown, yet the female presents features remarkable enough for a new genus to be set up. From the general anatomy it is certain that the worm belongs to Dracunculidae Leiper, 1912, but the structure of the esophagus differs fundamentally from that of *Philometra*, the only known piscine genus. I propose a new subfamily Philometrinae for *Philometra* Costa, 1845, *Philometroides* mihi, *Sanguinofilaria* mihi, *Clavinema* mihi, and the present genus.

The specific diagnosis is reserved until additional specimens come to hand.

Ichthyofilaria n. g.

GENERIC DIAGNOSIS. Philometridae Baylis et Daubney, 1926: Philometrinae. Body cylindrical, with pointed extremities. Mouth simple. Esophagus divided into an anterior muscular portion with two swellings separated by the nerve ring, and a shorter posterior portion; with a glandular appendix projecting into intestine. At the junction of these two parts of the esophagus is attached a long vermiform gland terminating on the anterior end of the intestine, which tapers posteriorly into a narrow, non-functional tube reaching to near tail end. Anterior ovary rudimentary; posterior one cylindrical, extending to near tail end or drawn up to posterior end of uterus. Uterus continuous, containing embryos. Male unknown. Parasitic in marine fishes.

Genotype. *Ichthyofilaria dasycotti.*

17. *Sanguinofilaria lateolabracis* n. g. n. sp.

DESCRIPTION. This worm occurs in the ovary or oviduct of various marine fishes from the Pacific or the Inland Sea, such as *Lateolabrax japonicus*, *Parapristipoma trilineatum*, *Epinephelus akaara*, etc.

The body, up to 23 cm in length and 0.9 mm in breadth, is uniformly broad throughout and bluntly pointed at the two extremities. The cuticle is thin and smooth. There are no head or tail papillae. The mouth is simple

*This is the length of the ovary plus germiduct.

and narrow, and leads directly into the esophagus. The latter, 1.0×0.08–0.1mm, is cylindrical and contains an esophageal gland on the dorsal side, except at the slightly swollen anterior muscular part. At the posterior end of the esophagus there projects into the intestine a small glandular appendix, between which and the esophagus a rudimentary ventriculus composed of a few antero-posteriorly compressed cells can be detected. The wide intestine tapers posteriorly into a fine string attached to the body wall near the tail end; its epithelium is studded with dark brown pigment granules obviously derived from the ingested blood of the host. The nerve ring lies at the narrowest part of the esophagus, about 0.21 mm from the head end. The excretory pore could not be made out.

There is a cylindrical ovary at each end of the body; immediately after arising from each end of the uterus they turn toward the middle of the body, but may often make another turn, as shown in fig. 27. The ovary plus germiduct measures 2.7–2.8 mm in length. The uterus is a simple continuous tube as in *Philometra*, and when fully gravid is distended with filariform embryos up to 0.45 mm long by 18 μ broad and having a long very fine tail. There is no vagina or vulva. The male is unknown.

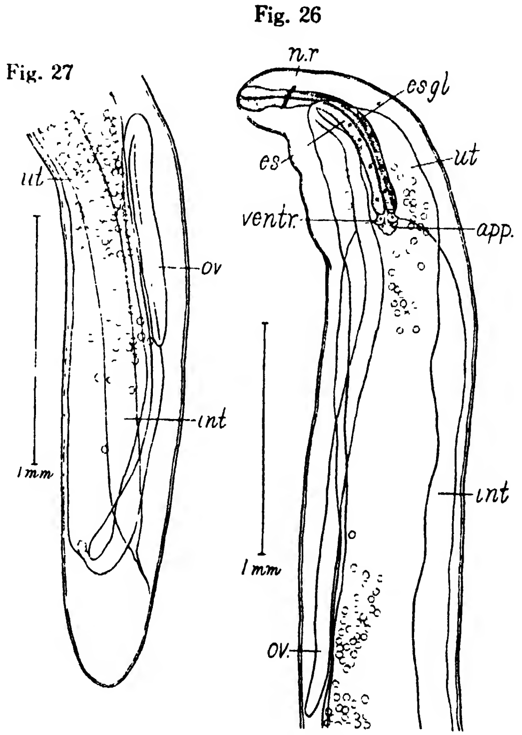

Fig. 26–27. *Sanguinofilaria lateolabracis.*
Fig. 26. Anterior extremity of immature female; lateral view.
Fig. 27. Posterior extremity of same; lateral view.

Discussion. This worm differs from the most closely related *Philometra* chiefly in possessing no head or tail papillae, and no definite muscular ventriculus.

Sanguinofilaria n. g.

Generic Diagnosis. Philometridae Baylis et Daubney, 1926. Philometrinae. Body cylindrical, long, slender, bluntly pointed at the extremities. No head or tail papillae. Mouth simple, leading directly into esophagus. Esophagus nearly cylindrical, containing glandular tissue on dorsal side except at slightly swollen anterior part, with a rudimentary ventriculus and a glandular appendix projecting into intestine. Intestine dark, otherwise as in *Philometra.* Ovary, uterus and embryos of *Philometra* type. Parasitic in ovary and oviduct of marine fishes.

Genotype. *Sanguinofilaria lateolabracis.*

Sanguinofilaria lateolabracis n. sp.

SPECIFIC DIAGNOSIS. *Sanguinofilaria;* with generic characters. Body up to 230×0.9 mm. Esophagus about 1.0×0.1 mm. Intestine wide. Embryo up to 0.45 mm long by 18 μ broad.

Habitat. Ovary or oviduct of *Lateolabrax japonicus* (type host), *Parapristipoma trilineatum, Epinephelus akaara.*

Localities. Inland Sea (type locality); Pacific coast of Wakayama Prefecture.

Dates. August 9, 1927 (type date); August 10, 1927; September 6, 1927; July 21, 1931; September 10, 1931.

Type and paratypes in my collection.

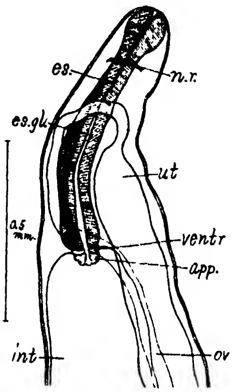

Fig. 28. Anterior extremity of female *Sanguinofilaria scomberomori;* lateral view.

18. *Sanguinofilaria scomberomori* n. sp.

On September 10, 1931, I found this species in the ovary of *Scomberomorus chinensis* from the Pacific. The body is up to 15 cm long by 0.9 mm broad and has more or less pointed extremities. The anterior end of the esophagus forms a muscular bulb 0.1–0.11 mm in diameter. The esophageal gland extends between the intestine and the nerve ring, which lies 0.17–0.2 mm from the head end. The embryos are up to 0.4 mm long.

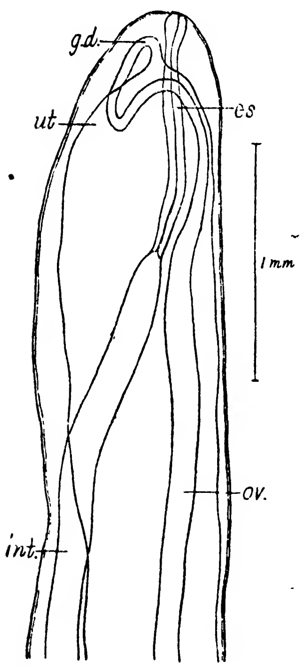

Fig. 29. Anterior extremity of female *Sanguinofilaria pinnicola;* dorsal view.

19. *Sanguinofilaria pinnicola* n. sp.

Three gravid females, up to 35 mm long, were found on June 10, 1930, in the fins of *Epinephelus akaara* from the Inland Sea. The whole cylindrical body is dark red in life.

Since the general anatomy of this worm coincides with that of the preceding species, I shall give here only the most important characters which distinguish the two.

The body is cylindrical with blunt extremities and measures up to 1.1 mm in breadth, but is definitely shorter than in *P. lateolabracis.* The intestine is relatively narrow without dark pigment granules in its epithelium. This fact may be accounted for by the different habitat. The embryos are relatively broader and up to 0.37 mm long.

20. *Clavinema parasiluri* n. g. n. sp.

DESCRIPTION. Some ten female adults of this worm were found in November, 1931, on the inner side of the operculum and in the submaxillar con-

nective tissue of *Parasilurus asotus* from Lake Ogura. The elongate club-shaped body is 5–12 mm long, with a maximum breadth of 1.5 mm near the anterior extremity. When alive it is yellowish brown with a green nuance due to the contents of the intestine and uterus. The cuticle is thin, but the longitudinal muscles of the body wall are well developed. The excretory pore could not be made out.

Fig. 31

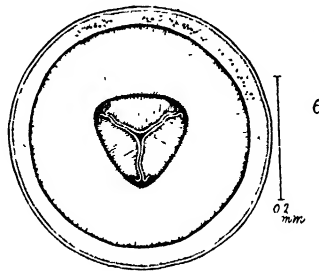

Fig. 30

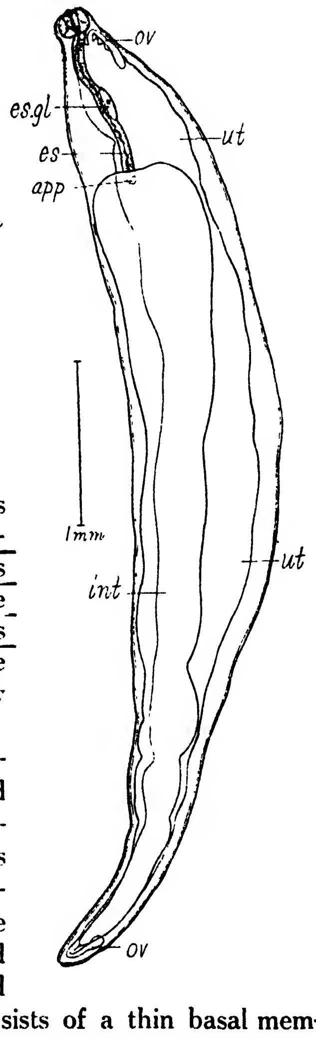

Fig. 30–31. *Clavinema parasiluri*.
Fig. 30. Female; ventral view.
Fig. 31. Head end; apical view.

The simple mouth, approximately triangular in apical view, leads directly into a large muscular bulb 0.18–0.25 mm long by 0.18–0.28 mm broad, with triradiate lumen and produced in front into three flat lobes projecting only slightly out of the mouth. There are no papillae around the mouth. The cylindrical, straight or sinuous esophagus proper is muscular, 0.8–1.2 × 0.06–0.1 mm, and has at about its middle a fusiform gland containing a nucleus at the center. The intestine is lined by a tall epithelium at the two extremities but by a more or less flat one elsewhere; it begins 0.8–1.1 mm from the head end as a voluminous tube but gradually narrows as it proceeds backwards and terminates near the posterior extremity of the body in a small, distally enlarged, solid appendage.

There is near each end of the body a spindle-shaped ovary 0.06–0.075 mm broad, with its free end directed toward each other. The germiduct is narrower than the ovary from which it arises, and empties into the extremity of the uterus, which is very voluminous and occupies almost the entire available space of the body. The front part of the uterus is distended with eggs but the hinder part is folded or twisted and contains few or no eggs. The uterine wall consists of a thin basal membrane and a single-layered epithelium with distinct cell membrane and becoming taller backward. At the posterior end of the body the uterus appears like a glandular duct.

The numerous spherical ova contained in the uterus along with a finely granular substance are about 18 μ in diameter and have a large vesicular nucleus containing a very conspicuous nucleolus. No developing eggs or em-

bryos have been observed, but it seems very probable that the worm is viviparous. The vagina and vulva are lacking.

DISCUSSION. This worm bears some resemblances to *Philometra*, but differs distinctly in body shape, the strong musculature of the body wall, the absence of head and tail papillae, and the extent of the esophageal gland. I refer this genus to Philometrinae.

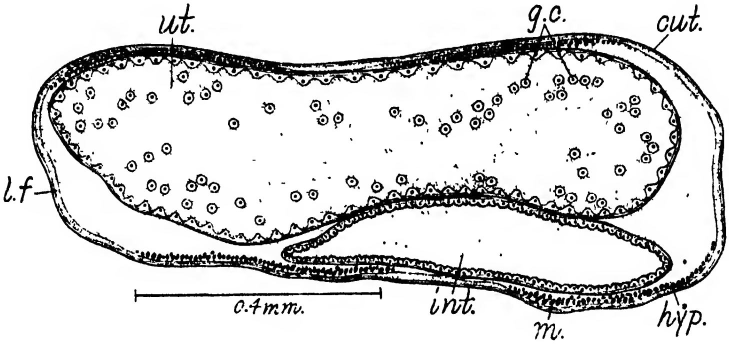

Fig. 32. Transverse section of female *Clavinema parasiluri.*

Clavinema n. g.

GENERIC DIAGNOSIS. Philometridae Baylis et Daubney, 1926. Philometrinae n. subfam. Body elongate claviform, with thick muscular wall. No head or tail papillae. Anterior part of esophagus bulbous, strongly muscular; posterior cylindrical, with small esophageal gland at about its middle. Intestine voluminous in front. Ovaries opposed, terminal. Uterus extending through almost entire length of body, distended with ova in front but folded and usually empty behind. Male unknown. Parasitic in freshwater fishes.

Genotype. *Clavinema parasiluri.*

Clavinema parasiluri n. sp.

SPECIFIC DIAGNOSIS. *Clavinema;* with generic characters. Body 5-12 mm long, up to 1.5 mm broad. Anterior part of esophagus 0.18–0.25 × 0.18–0.28 mm, posterior part 0.8–1.2 × 0.06–0.1 mm. Ovaries spindle-shaped, 0.06–0.075 mm broad. Ova about 18 μ in diameter.

Habitat. Under skin of *Parasilurus asotus.*

Locality and date. Lake Ogura; Nov. 1, 1931.

Type and paratypes in my collection.

ANGUILLICOLIDAE n. fam.

21. *Anguillicola globiceps* n. g. n. sp.

DESCRIPTION. This species is very common in the air bladder of *Anguilla japonica*, in which heavy infection causes a considerable thickening of the bladder wall, where the worms undergo their last ecdysis before entering the cavity of the bladder. The adults are characterized by the head end being somewhat constricted off and the exceedingly fine and close spinulation of the

cuticle. The body is up to 26×0.8 mm in the male and 60×1.8 mm in the female, with the maximum breadth near the abruptly tapering tail end. The broad lateral fields are conspicuously vacuolar and contain numerous small nuclei. In the body cavity there is abundant granular substance as in *Philometra*.

The simple mouth leads into a wide cavity 0.06–0.1 mm long and lined

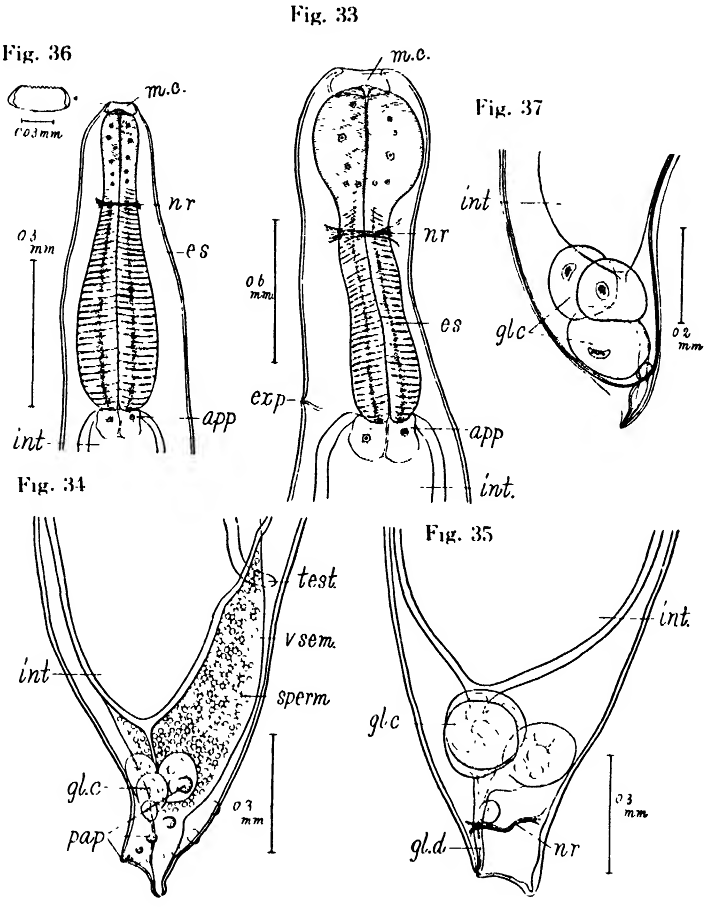

Fig. 33–37. *Anguillicola globiceps.*
Fig. 33. Anterior extremity of male; lateral view.
Fig. 34. Posterior extremity of male; lateral view
Fig. 35. Posterior extremity of female; lateral view.
Fig. 36. Anterior extremity of larva; dorsal view.
Fig 37. Posterior extremity of larva; dorsal view.

by a thick cuticle. The esophagus consists of an anterior, strongly muscular bulb up to 0.38–0.7 mm in diameter and containing a number of large residual nuclei, and a posterior cylindrical, musculo-glandular organ 1.13–1.8 mm long, to the posterior end of which is attached a ventriculus 0.2–0.3 mm long, pro-

jecting into the intestine and with a glandular tissue continuous with that of the posterior part of the esophagus mentioned above. The intestine, lined by a single-layered, cylindrical epithelium with nuclei at about the middle of its thickness, is distended with dark brown amorphous ingesta, which largely obscure the genital organs; it terminates blind before the tail end but is connected by a string of connective tissue with the caudal gland complex. The latter consists of three (one dorsal and two lateral) oval giant cells up to 0.15 mm broad and a smaller posterior one; in the female it has a straight common duct opening ventrally on a broad-based papilla just in front of the tail tip.

The nerve ring lies behind the bulbous swelling of the esophagus, 0.5–

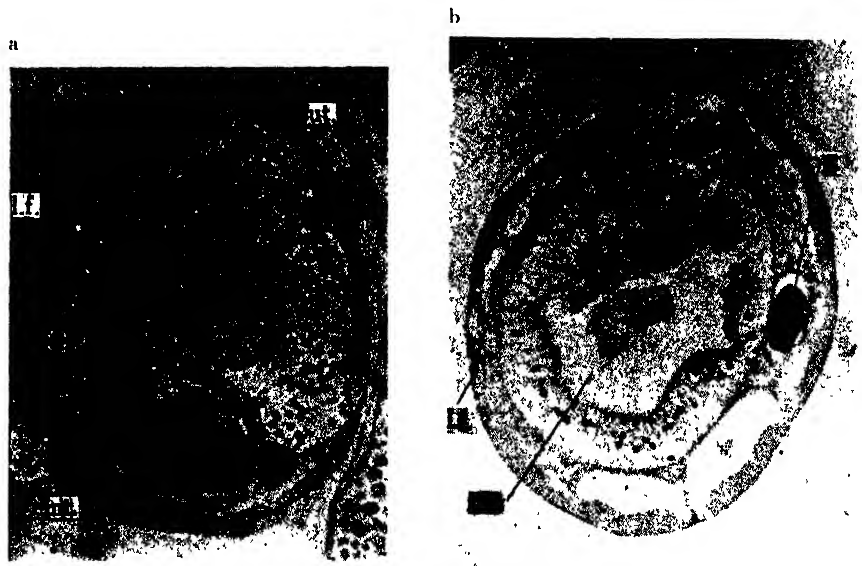

Fig. 38 *Anguillicola globiceps.*
a. Transverse section of gravid female.
b. Same of young.

0.6 mm from the head end. The excretory stem opens at about the level of the posterior end of the esophagus.

The slender tes is winds from near the posterior end of the body to somewhat further than the middle of the body, where it turns backwards, the turning point being variable according to individuals. The vesicula seminalis, up to 2.3 mm long by 0.5 mm broad, is distinctly constricted off from the distal part of the testis but tapers rapidly backward and leads into the ductus ejaculatorius, which, after joining the duct from the caudal gland complex, opens on a prominent papilla projecting farther backwards than the dorsally shifted true tail end. The spicules are lacking. There are 6 pairs of large caudal papillae, three in front of the male genital pore, one on either side of

it and two behind. The spermatozoa are granular.

The ovary and uterus are double; the posterior ovary begins some distance behind the anterior one and proceeds backwards to near the tail end to lead into the posterior uterus; both ovaries describe a very complex tortuous course as shown in fig. 39 b. In gravid females the anterior uterus extends forward to some distance behind the esophagus, while the posterior one reaching to near the tail end extends a little farther forward than the vulva, so that it turns back on itself before uniting with the anterior uterus. The short vagina lies at right angles to the body and is surrounded by a dense mass of gland-like cells. The vulva opens on the top of a very prominent cone containing the gland-like cells mentioned above, and lies approximately five times as far from the head end as from the tail end.

The free embryos of the uterus are up to about 0.28 mm long and have a long fine tail.

The larvae, which are undergoing the last ecdysis, have a chitinous mouth cavity bearing a row of minute tooth-like structures, and a very conspicuous caudal gland complex. The anterior end of the esophagus does not show so conspicuous a bulbous swelling as in the adult. In young individuals of the last developmental stage there are at the head end a number of elongate gland cells, whose distal ends are directed towards the mouth cavity. These gland cells tend to atrophy in older individuals.

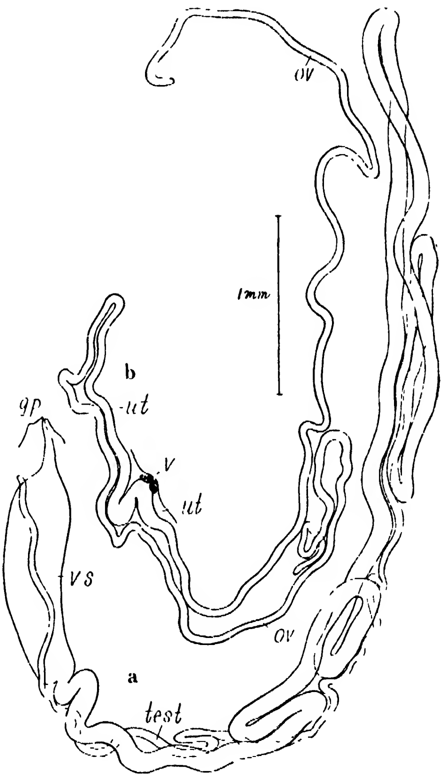

Fig. 39. *Anguillicola globiceps.*
a. Genital organs of male (semidiagrammatic); lateral view.
b. Same of female (semidiagrammatic); lateral view.

Discussion. There is no doubt that this species represents a new genus and family of the order Filarioidea, which may be defined as follows.

Anguillicolidae n. fam.

Family Diagnosis. Filarioidea Weinl., 1858. Body elongated Head without papillae. Mouth simple, with wide cavity. Esophagus divided into an anterior muscular bulb with three prominent front lobes and a cylindrical posterior musculo-glandular part, to the posterior end of which is attached a glandular ventriculus projecting into the intestine. Anus absent. Caudal gland complex present. Spicules lacking. Caudal papillae present. Testis beginning behind,

Fig. 40 a

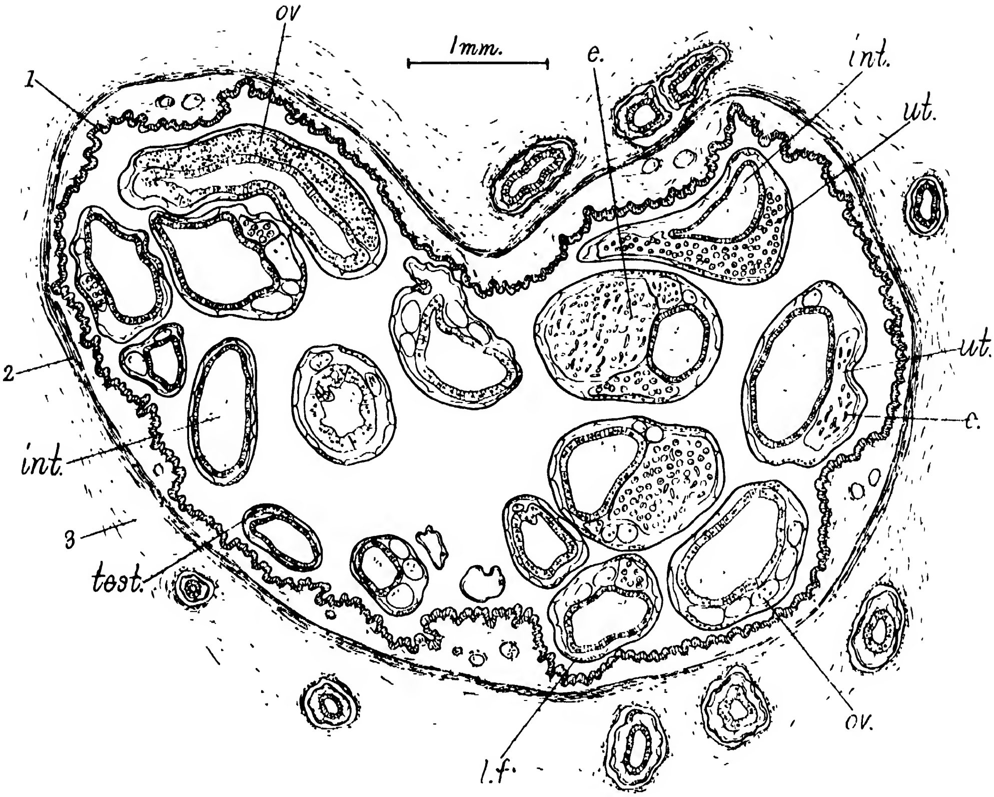

Fig. 40 b

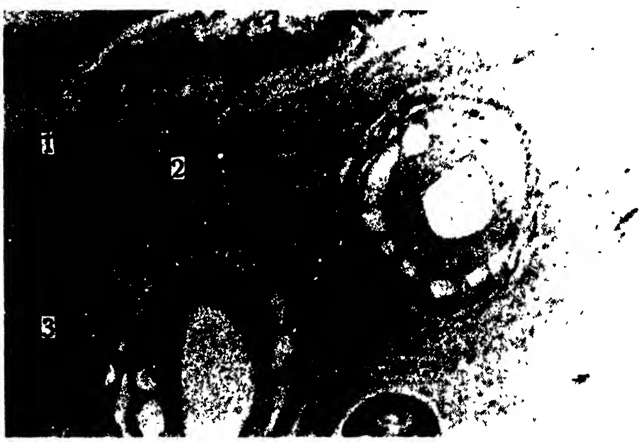

Fig. 40.

a. Air bladder of *Anguilla japonica* infected by *Anguillicola globiceps* in various developmental stages b. Wall of same showing two larvae penetrating it. 1 mucosa; 2 muscularis; 3 subserosa, greatly hypertrophied by infection.

reflexed in front. Ovary divided into anterior and posterior limbs, both beginning far in front of vulva. Uteri opposed. Vulva conspicuous, in posterior half of body. Viviparous. Parasitic in fishes.

Type genus. *Anguillicola* n. g.

Anguillicola n. g.

GENERIC DIAGNOSIS. Anguillicolidae n. fam.; with family characters. Cuticle very finely spinose throughout. Lateral fields broad, thin, with numerous nuclei. Excretory pore at about level of posterior end of esophagus. Head rounded off. Tail end abruptly pointed. Intestine dark, distended. Caudal gland cells discharging into ductus ejaculatorius in male but opening on a papilla in female. Testis beginning near tail end. Vesicula seminalis well developed. Ductus ejaculatorius opening on a prominent papilla projecting further backwards than dorsally displaced tail end. Vagina short, surrounded by dense mass of gland-like cells. Vulva opening on top of a prominent cone. Parasitic in air bladder of freshwater fishes.

Genotype. *Anguillicola globiceps.*

Anguillicola globiceps n. sp.

SPECIFIC DIAGNOSIS *Anguillicola;* with generic characters. Body up to 26×0.8 mm in male, 60×1.8 mm in female. Mouth cavity 0.06–0.1 mm long. Anterior esophageal bulb up to 0.38 mm across in male, 0.7 mm across in female. Nerve ring 0.5–0.6 mm from head end. Caudal gland consisting of three (one dorsal and two lateral) large and one smaller cells. 6 pairs of caudal papillae. Vulva approximately 5 times as far from head end as from tail end. Embryo up to 0.28 mm long.

Habitat. Air bladder of *Anguilla japonica.*

Locality and date. Lake Hamana; January 24, 1927.

Type and paratypes in my collection.

HEDRURIDAE Railliet, 1916

22. *Hedruris bryttosi* n. sp.

DESCRIPTION. Two mature males and five immature females from the stomach and intestine of *Bryttosus kawamebari* (Temm. et Schleg.) from River Asago.

The males, about 6–7 mm long by 0.15 mm broad, show conspicuous spiral twists in the posterior third of the body. The preanal ventral surface of the body is covered for a considerable distance with about 12 longitudinal rows of transversely incised cuticular elevations. The head is about 0.1 mm broad. Each lateral lip has a pair of marginal cuticular spines in front of the papilliform swellings on the outer surface. The nerve ring lies 0.2–0.25 mm from the head end. The dilated base of the buccal cavity has a chitinous, transversely folded wall as in *Hedruris tiara.* The glandular esophagus is 0.75 mm long by 0.063 mm broad. From the posterior end of the esophagus there project into the intestine the small ventriculus broader than long, and its glandular appendix. The two plump spicules are 170–175 μ long. The gubernaculum, about 66 μ long, lies immediately in front of the spicules and has a peculiar shape shown in the figure. The gradually tapering caudal extremity bears only 8 pairs of postanal papillae.

The immature females, 4.7–6.0 mm long by 0.2 mm broad, are very distinctly striated transversely on the posterior part except on the terminal holdfast organ. The head is 0.13–0.15 mm broad. The nerve ring and the excretory pore lie 0.21–0.25 mm and 0.33–0.38 mm respectively from the head end. The esophagus is 0.67–0.83 mm long. The terminal holdfast organ, whose inner wall has the appearance of a fine file, is 0.28–0.33 mm long and 0.26–0.27 mm in diameter; the hooks, 0.13–0.14 mm long, is hinged on the strongly chitinized ventral rim of the organ, and its basal disc is 0.09–0.1 mm in antero-posterior direction. The conspicuous gland cells associated with the base of the hook lie three on either side of the anus, which opens ventrally 0.25–0.35 mm from the end of the holdfast organ. The vulva lies 0.48–0.6 mm from the tail end.

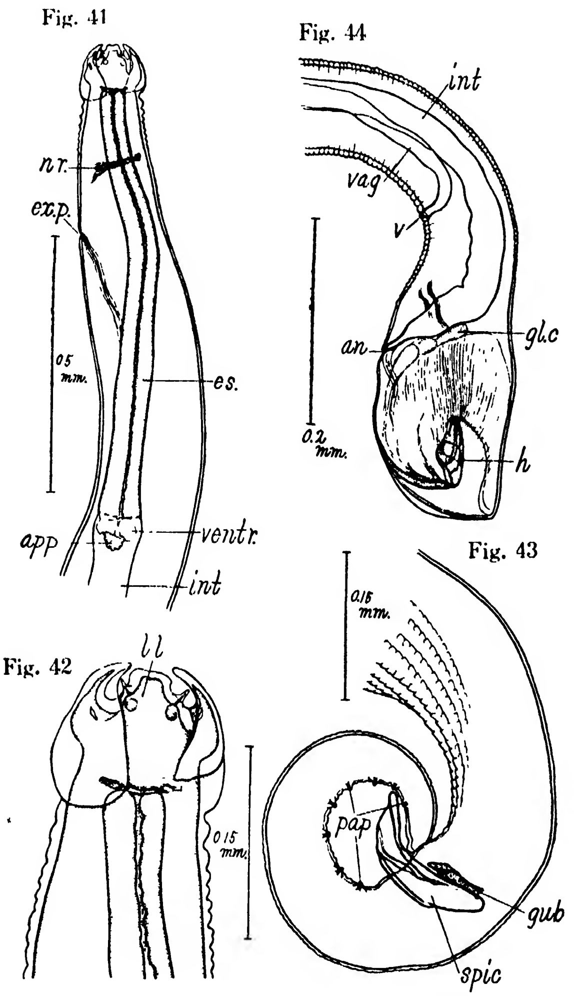

Fig. 41–44. *Hedruris bryttosi.*
Fig. 41. Anterior extremity of female; lateral view.
Fig. 42. Same magnified.
Fig. 43. Posterior extremity of male; lateral view.
Fig. 44. Same of female; lateral view.

Discussion. This species is the first of the genus found in fishes of Japan. It differs from *H. tiara* Van Cleave et Mueller, 1932, in the number of caudal papillae.

The specific diagnosis is reserved until gravid females are secured.

Literature cited

Van Cleave, H. J. and Mueller, J. F. Parasites of the Oneida Lake fishes. Part 1. Descriptions of new genera and new species. Roosevelt Wild Life Ann., Vol. 3, No. 1, 1932, p. 56–61.

PHYSALOPTERIDAE Leiper, 1908

23. *Heliconema anguillae* n. sp.

DESCRIPTION. Numerous adults from the stomach of *Anguilla japonica*.

MALE. The anteriorly attenuated body, up to 29 × 0.45mm, is spirally coiled posteriorly and has a bluntly pointed tail. The cuticle is up to 18 μ thick. In front of the cloaca the cuticle is raised into several longitudinal ridges which are sharply incised at intervals of 12–24 μ. The cervical papillae lie symmetrically just in front of the nerve ring, which is 0.28–0.3 mm apart from the head end. The excretory pore opens about midway between the nerve ring and the posterior end of the muscular part of the esophagus. There is a cephalic collarette which is 0.15-0.188 mm in diameter and whose rim may turn inside out. The mouth is bounded by two lateral lips, each of which bears a pointed tooth on the inner side. The mouth cavity is relatively wide

Fig. 45

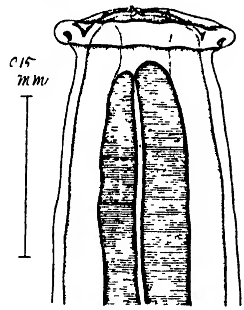

Fig. 46

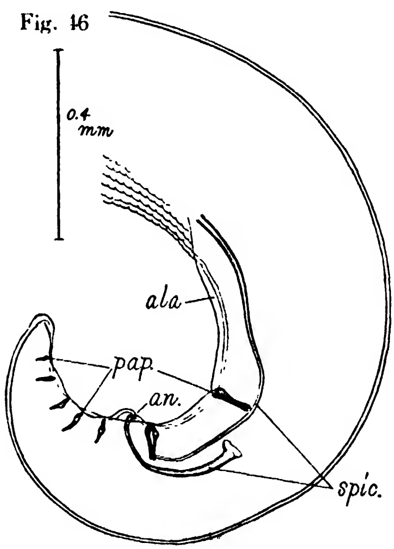

Fig. 45–46. *Heliconema anguillae*.
Fig. 45. Anterior extremity of female; lateral view.
Fig. 46. Posterior extremity of male; lateral view.

and 45 μ long. The esophagus is divided into an anterior muscular part 0.43–0.46 mm long and a posterior glandular one 2.7–3.1 mm long. From the posterior end of the latter a glandular (?) ventriculus broader than long projects into the intestine. The cloaca lies 0.33–0.41 mm from the tail end.

The slender, occasionally reflexed testis begins sometimes at the junction of the glandular part of the esophagus with the intestine and sometimes farther in front or behind. The short duct between the vesicula seminalis and the ductus ejaculatorius may form a bulbous swelling up to 0.1 mm in diameter, as shown in the diagrammatic figure 47 a. There are two dissimilar spicules; one is 0.67–0.7 mm long and 20 μ thick at the proximal part but very slender for the greater distal part and sharply pointed at the tip, while the other is

falcate, 0.27–0.3 mm long and up to 12 μ thick at the swollen distal end but 45 μ thick at the abruptly enlarged proximal end. The conspicuous caudal alae arise on either side about 0.62–0.75 mm in front of the cloaca. There are 9 pairs of costiform papillae more or less swollen near the tip; the four preanals of each side are separated by an interval of about 0.25 mm into two pairs, the posterior pair being just in front of the cloaca. The five postanals are arranged at almost equal intervals.

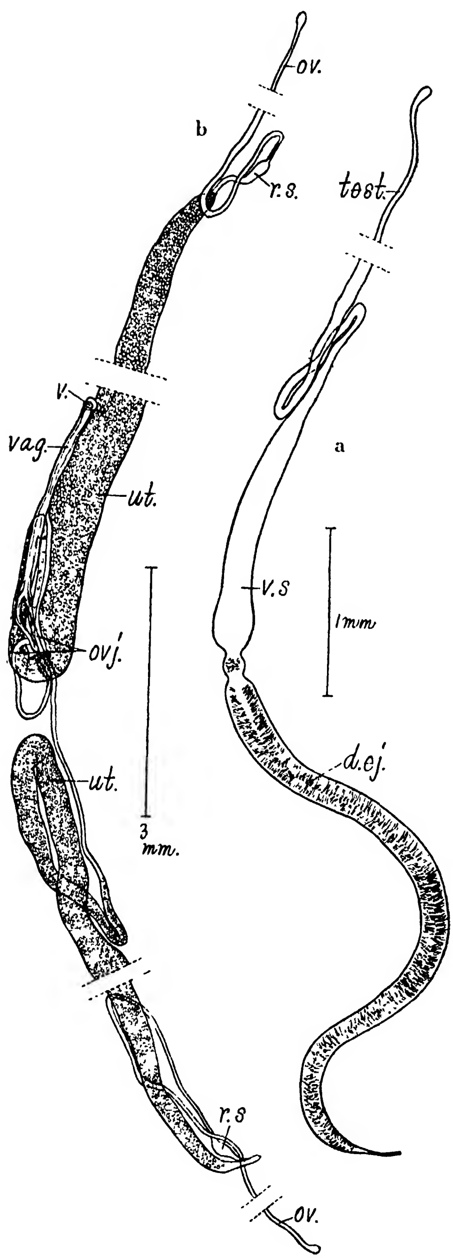

Fig. 47. *Heliconema anguillae.*
a. Genital organs of male (semidiagrammatic).
b. Same of female (semidiagrammatic).

FEMALE. The fully gravid females are 20–37 mm long and up to 0.6 mm broad. The position of the excretory pore and the structure of the mouth are as in the male. The nerve ring lies 0.25–0.35 mm from the head end. The anterior muscular part of the esophagus is 0.4–0.58 mm long and the posterior glandular 2.8–3.95 mm long. The anus lies 0.11–0.18 mm from the obtusely pointed tail end. The general arrangement of the genitalia is shown in fig. 47 b. The anterior ovary begins at variable levels of the glandular part of the esophagus and is usually directed anteriad, but may be sometimes reflexed. The posterior ovary extends as far as 0.23–1.0 mm from the tail end and its posterior end is usually straight, but may coil round the intestine. Each receptaculum seminis is well defined. The opposed uteri may touch at their reflexed ends which are usually separated by a distinct interval. The two ovijectors are long; the anterior one forms one or two loops before joining the straight posterior; after the union the epithelial cells are much larger but gradually decrease in height to be finally substituted by the cuticle of the vagina.

The sucker-like vulva with a large oval opening lies usually in front of the middle of the body. The elongate oval, thick-shelled, embryonated eggs are 45–47 μ long by 29–30 μ broad.

DISCUSSION. So far as I can gather from the literature* at my disposal, this species differs from *Heliconema heliconema* Travassos, 1919, in the absence of the adanal papilla and in the relative length of the two spicules. According to the generic diagnosis given by Baylis and Daubney, the head of the genotype resembles that of *Physaloptera*. If so, my worm is in this respect more closely related to *Proleptus* Dujardin, 1845, than to *Heliconema* Travassos, 1919, and therefore should represent a distinct genus.

Heliconema anguillae n. sp.

SPECIFIC DIAGNOSIS. Provisionally referred to *Heliconema* Travassos, 1919. Body up to 29 × 0.45 mm in male, 37 × 0.6 mm in female. Cephalic collarette 0.15–0.19 mm broad. Nerve ring 0.25–0.35 mm from head end. Excretory pore about halfway between nerve ring and posterior end of muscular part of esophagus. Mouth cavity wide, 42–50 μ long. Muscular part of esophagus 0.4–0.58 mm long, glandular part 2.7–3.95 mm long. Tail 0.33–0.41 mm long in male, 0.11–0.18 mm long in female. Caudal alae conspicuous, with 9 pairs of costiform, distally swollen papillae; four preanals of each side in two pairs, one just in front of cloacal aperture. Longer slender spicule 0.67–0.7 mm long, shorter 0.27–0.3 mm long. Two uteri opposed, may touch at their reflexed ends. Anterior ovijector looped. Vagina up to 2.0 mm long. Vulva usually preequatorial, occasionally postequatorial. Eggs elongate oval, embryonated, 45–47 × 29–30 μ.

Habitat. Stomach of *Anguilla japonica*.

Locality. Unknown.

Date. February 5, 1927.

Type and paratypes in my collection.

THELAZIIDAE Railliet, 1916

24. *Rhabdochona zacconis* n. sp.

SPECIFIC DIAGNOSIS. *Rhabdochona* Railliet, 1916. Body 8–9.6 × 0.15 mm in the male, 10–42 × 0.27 mm in the female. Tail 0.4–0.45 mm long in the male, 0.2–0.41 mm in the female. Head 21–48 μ broad. Infundibular buccal cavity 0.1–0.22 mm long, with 12 pointed teeth in front, but without longitudinal ribs. Esophagus with anterior muscular part 0.35–0.42 mm long in the male and up to 0.63 mm long in the female; posterior glandular 3.7–4.1 mm long in the male and up to 7.25 mm long in the female. Longer spicule tubular, 0.48 mm long, with barbs at distal end; shorter one broad, 0.12 mm long, with blunt barbs at its distal end. 9 pairs of preanal and 6 pairs of postanal papillae. Vulva dividing body length in ratio of 1.2–1.4 : 1. Eggs elliptical, thick-shelled, embryonated, 31–36 × 18–24 μ.

Habitat. Small intestine of *Zacco platypus* (Temm. et Schleg.) (type host) and *Liobagrus reini* Hilgendorf.

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*Baylis and Daubney: A synopsis of the families and genera of nematoda, 1926, p. 222–223. Yorke and Maplestone: The nematode parasites of vertebrates, 1926, p. 355.

Fig. 48

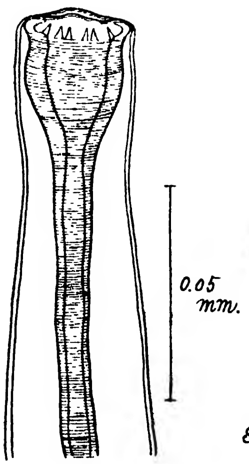

Fig. 49

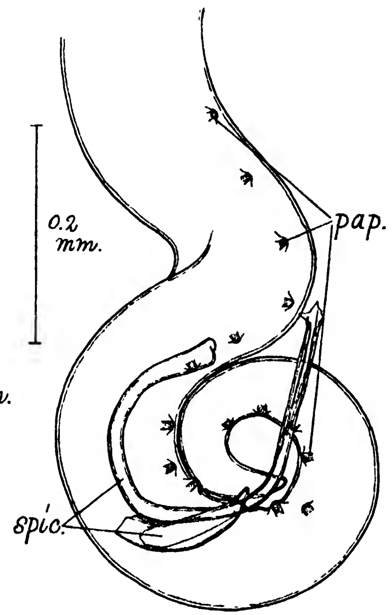

Fig. 48–49. *Rhabdochona zacconis.*
Fig. 48. Anterior extremity of female; lateral view.
Fig. 49. Posterior extremity of male; lateral view.

Locality and date. Nagano Prefecture; August 16, 1927.

Type and paratypes in my collection.

This species differs from the closely related *R. salvelini* Fujita, 1927, chiefly in the length of spicules, in the number of pre- and postanal papillae, and in egg size.

25. *Rhabdochona amago* n. sp.

Specific Diagnosis. *Rhabdochona* Railliet, 1916. Male unknown. Female up to 25 mm by 0.35 mm broad, with pointed tail 0.3–0.37mm long. Head 33–37 μ broad. Infundibular buccal cavity 0.14–0.17 mm long, with 12 teeth in front, but without longitudinal ribs. Esophagus with anterior muscular part 0.35–0.38 mm long and posterior glandular 3.4–4.1 mm long. Nerve ring 0.25–0.28 mm from head end. Excretory pore 0.38–0.46 mm from head end. Vulva at about middle of body. Eggs elliptical, thick-shelled, embryonated, 39–42 × 24–27 μ.

Habitat. Small intestine of "amago" (a salmonid whose scientific name is not settled).

Locality and date. Tazima Province; April 21, 1933.

Type and paratypes in my collection.

Discussion. The female of this species is characterized by the position of the vulva and the size of eggs; the latter is intermediate between that of *R. salvelini* Fujita and of *R. zacconis* mihi.

The specific name is derived from the Japanese name of the host.

Literature Cited

Fujita, T. On new species of nematodes from fishes of Lake Biwa. Japan. Jour. Zool., Vol. 1, No. 6, 1928, p. 169–170.

26. *Rhabdochona girellae* n. sp.

Description. One male and four female adults from the stomach of *Girella punctata* from the Pacific coast of Wakayama and Mie Prefectures.

The almost filiform body is 10.16×0.088 mm in the male and 19.09–24.2× 0.15–0.2 mm in the female. The cuticle is finely striated transversely. The head is 24–36 μ broad. The cervical papillae lie 0.1–0.12 mm from the head end. The excretory duct opens a little behind the nerve ring, which lies 0.17–0.23 mm from the head end. The two lateral lips are small. The buccal cavity, 0.138–0.26 mm long and funnel-shaped anteriorly, has no teeth or longitudinal ribs. The anterior muscular portion of the esophagus is 0.25–0.31 mm long, while the posterior glandular is 1.57–3.66 mm long. The tail is rather blunt and about 0.11 mm long in the male but moderately acute and 0.11–0.14 mm long in the female.

There are on either side three preanal, one adanal and ten postanal papillae. Of the three posteriormost papillae one is subventral and the other two are lateral. The spicules are 0.4 mm and 0.09 mm in length respectively; the longer one forms at its distal end a vesicle with a chitinous support which is continued into the shaft of the spicule; the shorter is broad and arcuate.

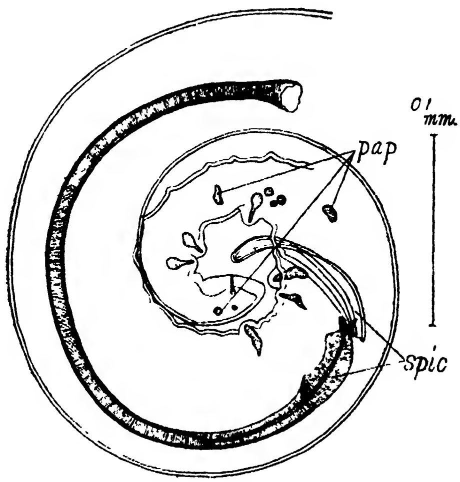

Fig. 50. Posterior extremity of male *Rhabdochona girellae*; lateral view.

The vulva divides the body length in the proportion of 1 : 1.2–1.5. The elliptical, thick-shelled, embryonated eggs are 33–36×15–16 μ.

DISCUSSION. This is the first species of the genus from marine fishes, and seems very characteristic of *Girella punctata*.

Rhabdochona girellae n. sp.

SPECIFIC DIAGNOSIS. *Rhabdochona* Railliet, 1916. Body about 10–24 mm long and up to 0.2 mm broad. Cervical papillae and nerve ring 0.1–0.12 mm and 0.17–0.23 mm respectively from head end. Buccal cavity 0.138–0.26 mm long, without teeth or longitudinal ribs. Muscular part of esophagus 0.25–0.31 mm long, glandular part 1.57–3.66 mm long. With 3 preanal, 1 adanal and 10 postanal papillae on each side, at unequal intervals. Longer spicule vesicular at distal end, about 0.4 mm long; shorter one broad, arcuate, 0.09 mm long. Vulva dividing body length in ratio of 1:1.2–1.5. Eggs 33–36×15–16 μ.

Habitat. Stomach of *Girella punctata*.

Locality. Pacific coast of Wakayama (type locality) and Mie Prefectures.

Dates. August 19, 1926 (type date); June 5, 1927.

Type and paratypes in my collection.

27. *Rhabdochona gymnocranii* n. sp.

DESCRIPTION. Two gravid females found on August 13, 1930, in the

stomach of *Gymnocranius griseus* (Temm. et Schleg.) from the Inland Sea. The body is filiform and measures 17.9–21.73 mm in length and 0.12 mm in maximum breadth. The relatively thick cuticle is very finely striated transversely. The head is about 16 μ broad. The mouth has two small lateral teeth projecting slightly over the lips. The buccal cavity is 135–144 μ long. The anterior muscular part of the esophagus is 216–225 μ long by 24–27 μ broad and the posterior glandular 1.16–1.25 mm long by 45–48 μ broad. The nerve ring and the excretory pore lie about 0.18 mm and 0.27 mm respectively from the head end. The pointed tail is 0.11 mm long.

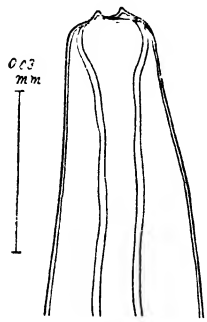

Fig. 51. Anterior extremity of female *Rhabdochona gymnocranii*.

The anterior ovary extends to the beginning of the intestine, while the posterior one terminates 0.15–0.3 mm in front of the anus. The vulva with a thick lip lies just behind the middle of the body. The elliptical, thick-shelled, embryonated eggs are 42–45 × 25–28 μ.

This is the second species of the genus from marine fishes and is distinguished from the preceding chiefly by the presence of buccal teeth, the position of the vulva and the size of eggs.

The specific diagnosis is reserved until male adults are obtained.

28. *Cystidicola salvelini* (Fujita, 1920) Fujita, 1928

A comparative study of my specimens from the stomach and intestine of *Salvelinus malma* from Lake Biwa with Fujita's detailed description of 1920 has brought to light some minor differences given below.

The gravid females at my disposal are up to 14.1 mm long, while the males are up to 6.3 mm long. The finely striated cuticle is up to 9 μ thick in the female. Fujita states that the excretory pore lies 0.02 mm from the head end, but in my specimens it lies 0.16–0.28 mm from the head end. The nerve ring lies 0.13–0.21 mm from the head end. The anterior muscular part of the esophagus is more or less distinctly sinuous, as represented by Fujita in his paper of 1928; it has a straight length of 0.6–1.05 mm; the posterior glandular part is 1.38–2.68 mm long. The anus lies 0.13–0.15 mm from the tail end in the male but only 0.065–0.075 mm in the female.

The longer spicule is 0.33–0.38 mm long and the shorter one, sickle-shaped in lateral view, 0.138–0.144 mm long; Fujita gives them as 0.24 mm and 0.117 mm long respectively. There are 4 preanal and 5 postanal pairs of costiform papillae; the anteriormost papilla is 42 μ long. The first two postanals are so close together on each side as to be readily mistaken for one.

The vulva is situated 6.25 mm from the head end and 5.1 mm from the tail end in one specimen. The ellipsoidal, thick-shelled, embryonated eggs are 39–45 μ long by 24–30 μ broad; Fujita gives them as 50 × 27 μ.

In 1928 Fujita found this species in *Salvelinus malma* from the same

locality where my own specimens came from.

29. *Cystidicola salmonicola* (Ishii, 1916)

A single gravid female was found in the air bladder of *Salvelinus malma* from Lake Biwa. The original report was from Hokkaido, so that like the preceding species it seems to be very widely distributed.

LITERATURE CITED

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Fujita, T. Further studies on nematodes from fishes of Lake Biwa. Dobutu Gaku Zassi, Vol. 40, 1928, p. 307 (Japanese) and p. 311 (English abstract).

Ishii, S. On *Ancyracanthus salmonicola* n. sp. from the air bladder of Japanese trout. Dobutu Gaku Zassi, Vol. 28, 1916, p. 125-136. (Japanese.)

RICTULARIIDAE Railliet, 1916

30. *Spinitectus gigi* Fujita, 1927

On the basis of two males and two gravid females from the stomach of *Pelteobagrus nudiceps* (Sauvage) I venture to supplement Fujita's description and to correct his errors.

The two males are about 6.0 mm long by 0.12–0.2 mm broad. The anterior muscular part of the esophagus beginning 51–60 μ behind the head end is 0.22–0.26 mm long and the thicker posterior glandular 0.95–0.96 mm long. The body spines, about 12 μ long, begin about 0.13 mm from the tip and are arranged in circles of 23–30 each. Fujita states that the two spicules are similar and 1.27 mm long, but in my specimens they are entirely different in size and shape as in other known members of the genus, one being 0.8–0.9 mm long and slightly undulating distally in side view, and the other only 0.11–0.12 mm long, with two small ventral barbs at its anterior end. There are 10 pairs of thick-stalked papillae in all, four being preanal. The two first postanals are close to the cloacal opening; the third postanals lie 30–36 μ behind the second; the last three pairs are rudimentary and lie close together near the tip of the body.

The females are 11.0 mm long by 0.22 mm broad. The whole body except the head cone is covered by spines arranged in rings of 22–23 each and up to 15 μ long in front but gradually becoming smaller posteriorly; some of the rings are broken into semicircles discordant at the end; the first ring of 22–27 spines lies 0.13–0.15 mm from the head end; on the tail the spines are very fine and the circles are close together. The anterior muscular part of the esophagus beginning 66–75 μ behind the tip of the head is 0.33–0.375 mm long and the posterior glandular 0.9–1.25 mm long, the boundary between the two lying between the fifth and sixth circles of spines or farther behind. The gravid uterus extends forwards to about 0.6 mm behind the esophagus. The

vulva lies 0.5–0.55 mm in front of the abruptly and obtusely pointed tail end, and the anus 0.063–0.08 mm in front of the latter. The muscular vagina is directed anteriad. The elongate oval, thick-shelled, embryonated eggs as mounted in glycerine-gelatine are 28–33 × 20–23 μ.

Fig. 52

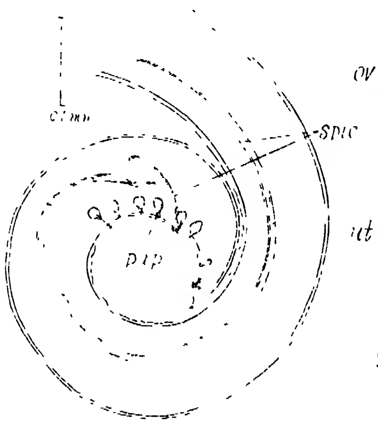

Fig. 53

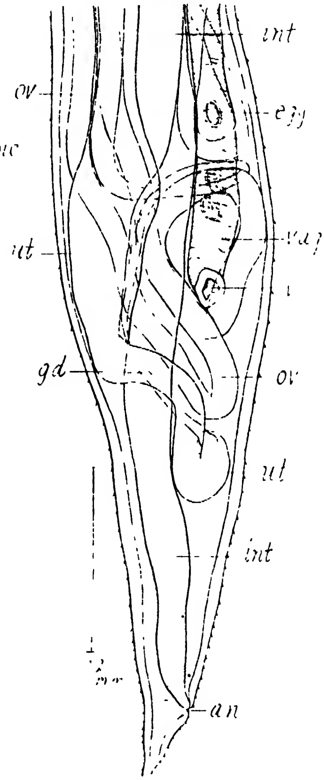

Fig. 52–53. *Spinitectus gigi* Fujita, 1927.
Fig. 52. Posterior extremity of male; lateral view.
Fig. 53. Same of female; ventrolateral view.

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Fujita, T. Parasitic worms from fishes of Lake Biwa. II. Dobutu Gaku Zassi, Vol. 39, No. 462, 1927, p. 159–160. (Japanese.)

31. *Spinitectus mogurndae* n. sp.

SPECIFIC DIAGNOSIS. *Spinitectus* Fourment, 1883. Gravid females 3.6–5.12 mm long, 0.1–0.12 mm broad, spined as in *Spinitectus gigi* Fujita, 1927. First ring of spines 0.1–0.11 mm from head end. Complete anterior rings consisting each of 24–42 spines about 9 μ long. Anterior muscular part of esophagus beginning 42–63 μ behind head end, 0.25–0.35 mm long; posterior glandular 0.38–0.65 mm long. Anus and vulva 0.05–0.063 mm and 0.25–0.4 mm from tail end respectively. Eggs embryonated, 32–36 × 21–24 μ. Male unknown.

Habitat. Stomach and intestine of *Mogurnda obscura* (Temm. et Schleg).

Locality and date. Lake Ogura; June 9, 1932.

Type and paratypes in my collection.

DISCUSSION. This species resembles the preceding very closely, but differs from it chiefly in body size and the number of body spines in each circle.

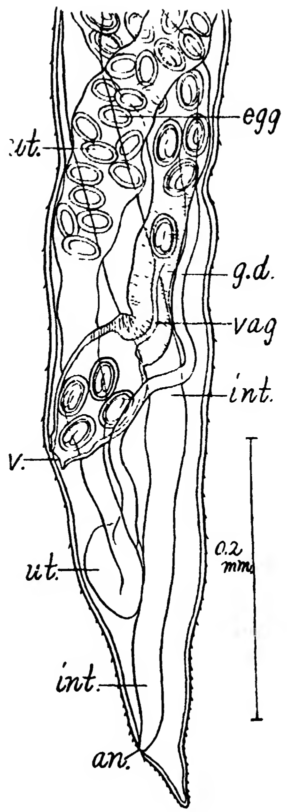


Fig. 54. Posterior extremity of female *Spinitectus mogurndae*; lateral view.

CAMALLANIDAE Railliet et Henry, 1915

32. *Camallanus cotti* (Fujita, 1927)

Fujita described this species in detail, but unfortunately his account of the anatomy of the ovary and uterus is very inaccurate; I will therefore make some emendations from observations on my materials from the end gut of *Mogurnda obscura*, *Cottus pollux*, *Zacco platypus*, *Z. temmincki* (Temm. et Schleg.), *Chaenogobius macrognathos* (Bleeker) and *Leuciscus hakonensis*.

In a not yet fully gravid female, the ovary begins some distance behind the vulva as a slender tube running forwards and turning back on itself just behind the vulva, becoming wider as it proceeds backwards and making another turn in front of the origin of the vagina, whence it passes as a relatively wide tube containing mature germ cells straight forward along the uterus and intestine to some distance behind the glandular esophagus and there narrows into the germiduct coiled around the intestine and esophagus and proceeding forward. This wide portion was mistaken by Fujita for the "anterior uterus". The germiduct leads into the very wide uterus at about the middle of the muscular portion of the esophagus. Fujita says that

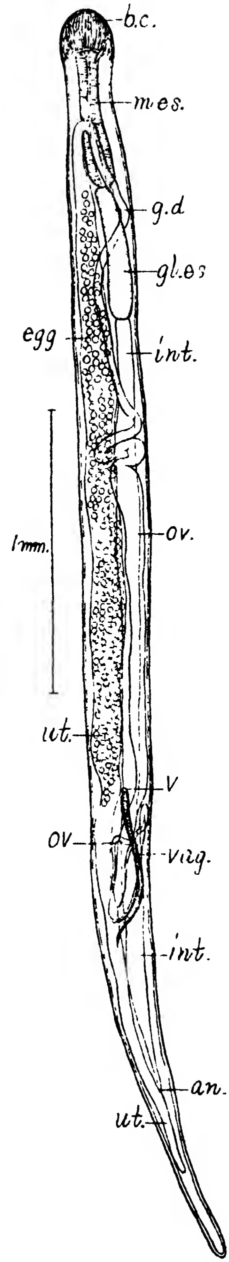


Fig. 55. Female *Camallanus cotti* Fujita, 1927.

the uterus is Y-shaped, but as a matter of fact it is a simple continuous tube extending for almost the entire length of the body and giving rise to the vagina behind the vulva. The latter is somewhat variable in position, lying 2.8 mm behind the head end in a specimen 4.48 mm long (fig. 55), but usually divides the body length in the ratio of 1.2–1.5 : 1.

The largest gravid female from *Chaenogobius macrognathos* is 7.33 mm long, with a tail 0.9 mm long. The chitinous valve of the buccal capsule has usually about 18 longitudinal ribs. The middle process of the trident is just as long as the lateral ones in all my specimens. The posterior glandular part of the esophagus, up to 0.53 mm long, has an appendix projecting into the intestine. The two spicules are slightly different in length and breadth.

The fully developed embryos with a boring tooth at the head end are up to about 0.36 mm long by 18 μ broad.

LITERATURE CITED

Fujita, T. On new species of nematodes from fishes of Lake Biwa. Dobutu Gaku Zassi, Vol. 39, 1927, p. 42–43 (Japanese); and Japan. Jour. Zool., Vol. 1, No. 6, 1928, p. 170–171.

33. *Procamallanus sigani* n. sp.

DESCRIPTION. A number of male and female adults were found in the small intestine of *Siganus fuscescens* (Houttuyn) from the Inland Sea and the Pacific coast of Mie and Wakayama Prefectures. The body is 10–14 mm long in the male and 19–27 mm long in the female, with a maximum breadth of 0.55 mm. The cuticle up to 6 μ thick has very fine transverse striations. The buccal capsule with smooth inner and outer surfaces is 0.093–0.105 mm long by 0.08–0.114 mm broad in the male and 0.11–0.12 mm long by 0.11–0.138 mm broad in the female, and has a very distinct basal ring. The distance of the nerve ring from the head end is 0.22–0.26 mm in the male and 0.28–0.33 mm in the female. The excretory pore could not be detected with certainty.

The anterior muscular part of the esophagus is 0.32–0.41 × 0.07–0.08 mm in the male and 0.4–0.51 × 0.1–0.135 mm in the female, while the posterior glandular is 0.58–0.68 × 0.066–0.088 mm in the male and 0.63–0.91 × 0.11–0.13 mm in the female. The anus lies in the male 0.15–0.2 mm and in the female 0.3–0.38 mm, from the not very sharp tail end.

The testis beginning 1.8–2.7 mm from the head end is broader posteriorly but narrows abruptly at its junction with the relatively short twisted vas deferens. The vesicula seminalis, about 4 mm long, is sharply constricted off at both ends. The ductus ejaculatorius lined by a tall cylindrical epithelium is about 1.5 mm long. The longer spicule with a special curvature at the distal end is about 0.4 mm long and the shorter 0.12–0.15 mm long. The caudal alae are continuous in front and supported on either side by a series of three long slender preanal and three similar but shorter postanal papillae. Behind the anus there are, in addition, three papillae out of the series: one on the inner side and the other two on the outer side of the postanals mentioned

above. The preanal region bounded by the alae has numerous strong transverse muscular bands under the cuticle.

The proximal end of the ovary lies at very different levels in different individuals. In a gravid specimen 21.5 mm long it lies 1.34 mm behind the vulva, but may be on the same level with the latter or further in front; while in a specimen 26 mm long it is only 4.1 mm from the head end, and the germiduct forms an approximately 8-shaped loop for lack of space. The simple, tubular uterus begins 1.4–2.4 mm from the head end and terminates 0.75–2.8mm from the tail end in a solid vermiform, forwardly or backwardly directed appendage. The muscular vagina, 0.75–1.2 mm long, is usually straight but may be reflexed at the proximal end. The vulva lies 7.3–11.3 mm from the head end, dividing the body length in the proportion of 1 : 1.3–1.75; the anterior lip, about 60 μ broad, consisting of a thin cuticular membrane, while the papilliform posterior one is 18 μ long by 30 μ broad. The fully developed embryo with a very fine tail is up to 0.52 mm long and 15 μ broad.

Fig. 56

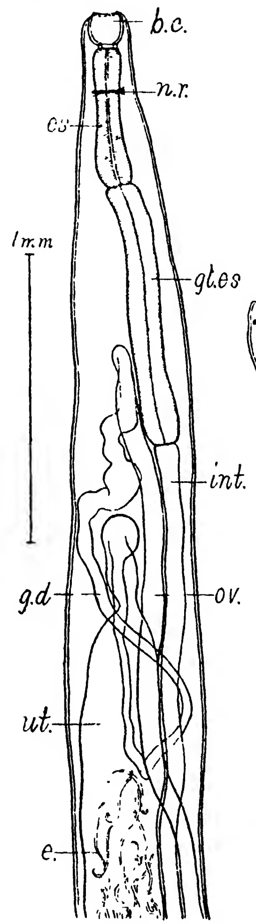


Fig. 57

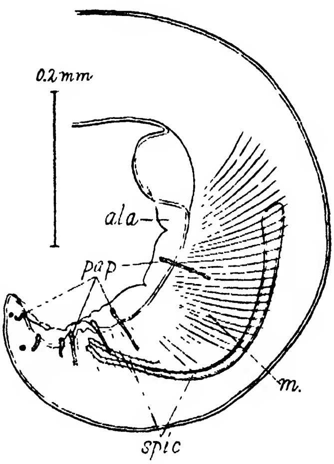


Fig. 56–57. *Procamallanus sigani.*
Fig. 56. Anterior extremity of female; lateral view.
Fig. 57. Posterior extremity of male; lateral view.

DISCUSSION. This species differs from the very closely related *Procamallanus sphaeroconchus* Törnquist, 1931, chiefly in the number of anal papillae.

Procamallanus sigani n. sp.

SPECIFIC DIAGNOSIS. *Procamallanus* Baylis, 1923; with generic characters. Body finely striated transversely, not very acute posteriorly, 10–14 mm long in male, 19–27 mm in female. Buccal capsule spherical, smooth, 0.093–0.12 × 0.08–0.138 mm. Anterior muscular part of esophagus 0.32–0.51 × 0.07–0.135 mm, posterior glandular 0.58–0.91 × 0.066–0.13 mm. Nerve ring 0.22–0.33 mm from head end. Anus 0.15–0.2 mm from tail end in male, 0.3–0.38 mm in female. Caudal alae continuous in front, with 3 preanal and 3 postanal pairs of papillae, besides 3 pairs of accessory

postanal papillae, one inside and two outside caudal alae. Preanal region with numerous strong transverse muscular bands. Longer spicule about 0.4 mm long, shorter 0.12 0.15 mm long. Vulva dividing body length in proportion of 1:1.3–1.75, with anterior membranous and posterior papilliform lips. Embryo up to 0.52 mm long by 15 μ broad.

Habitat. Small intestine of *Siganus fuscescens*

Localities. Inland Sea (type locality); Pacific coast.

Dates. July 29, 1927 (type date); August 8, 1926: August 20, 1934.

Type and paratypes in my collection.

LITERATURE CITED

Tornquist, N. Die Nematodenfamilien Cucullanidae und Camallanidae. Göteborgs kungl. Vetenskaps- och Vitterhets-samhälles Handlingar, Ser. B, Bd 2, No. 3, 1931, p. 306–312.

34. *Procamallanus parasiluri* Fujita, 1927

The gravid females at my disposal are up to 12.3 mm long (Fujita : 6.0 mm) and a single immature male is 1.44 mm long by 0.11 mm broad. The wide mouth opening has a membranous cuticular border supported by six spinelets set at equal intervals in the notches on the thickened anterior margin of the buccal capsule and with very fine muscular fibrils attached to them and running backwards on the smooth outer surface of the capsule. The capsule itself is 108–114 × 90–96 μ in the female and 90 × 75 μ in the male. and has discontinuous spiral ridges on the inner surface. The cuticle is up to 30 μ thick at about the level of the nerve ring, which lies 0.23–0.25 mm from the head end. The excretory pore could not be definitely located. The anterior muscular portion of the esophagus is 0.475–0.51 × 0.06 – 0.08 mm and the posterior glandular 0.51–0.6 × 0.05–0.07mm in the female, while in the immature male they are 0.35 × 0.05 mm and 0.338 × 0.05 mm respectively.

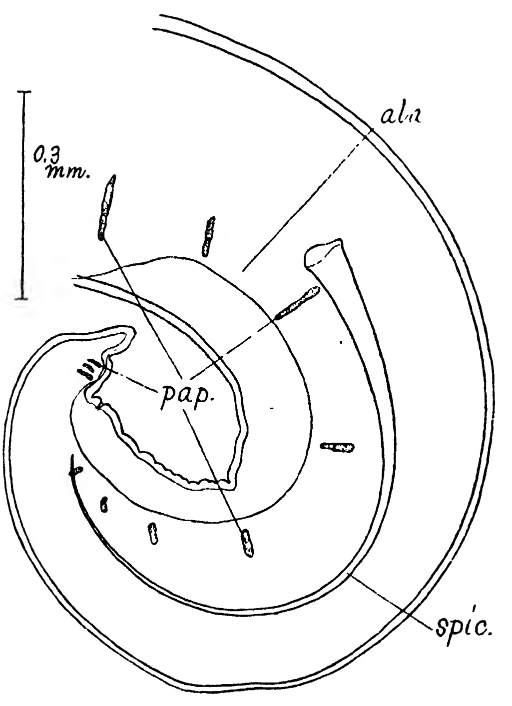


Fig. 57. Posterior extremity of male *Procamallanus parasiluri* (Fujita, 1927); lateral view.

The single spicule* of the immature male is elongate horn-shaped and

*If the spicule is single in adults also, this species should represent a new genus; the finding of adult male is therefore awaited with interest.

0.25 mm long. There is no accessory piece. The not very conspicuous subventral caudal alae have on either side 8 long, stalked preanal and 3 similar postanal papillae; the former arranged tandem with posteriorly diminishing intervals, but the latter close together with equal intervals. The tail end of the male is not triradiate at the tip.

The female genitalia were described by Fujita, but I want to point out some important characters. The vulva has no conspicuous lips and lies approximately four times as far from the head end as from the tail end. The subglobular eggs are 24–27 μ in diameter; the ova are segmented but not embryonated.

LITERATURE CITED

Baylis, H. A. Report on a collection of parasitic nematodes, mainly from Egypt. Parasit., Vol. 15, 1923, p. 26–28.

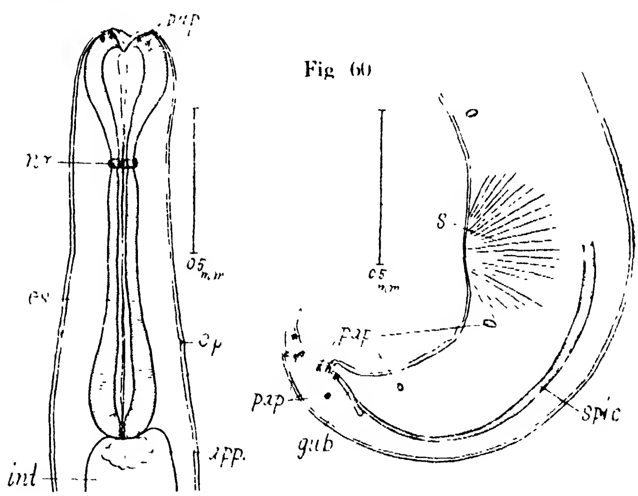
Fujita, T. On new species of nematodes from fishes of Lake Biwa. Dobutu Gaku Zassi, Vol. 39, 1927, p. 41 (Japanese); and Japan. Jour. Zool., Vol. 1, p. 167–170.

CUCULLANIDAE Cobbold, 1879

Cucullanus robustus n. sp.

DESCRIPTION. Three males and four gravid females were found in the intestine of *Conger myriaster* from the Inland Sea and Ise Bay. The body, almost uniformly broad except at the extremities, is 7.18–14.5 × 0.4–0.57 mm in the male and 13.66–16.0 × 0.4–0.62 mm in the female. The head is only slightly broader than the neck, which is 0.2–0.35 mm broad. The very sharply pointed tail is 0.25–0.3 mm long in the male and 0.4–0.44 mm long in the female. The cervical papillae lying between the posterior end of the esophagus and the nerve ring, is farther away from the latter, which is 0.4–0.52 mm apart from the head end. The excretory pore appears to open behind the esophagus. Each lateral lip has a narrow denticulate

Fig. 59



Fi. 59–60. *Cucullanus robustus*.
Fig 59. Anterior extremity of male; dorsal view.
Fig. 60. Posterior extremity of male; lateral view.

cuticular border and three small papillae on its outer surface, as in other members of the genus. The false buccal capsule is 0.18–0.28 mm broad. The esophagus is 0.88–1.41 mm long by 0.138–0.238 mm broad, and from its posterior end a valvular appendix projects into the intestine. There is no intestinal cecum. The sphincter at the posterior end of the intestine is not very strongly developed. The ductus ejaculatorius lined by a cylindrical epithelium may show a bulbous swelling up to 0.1 mm broad. The cloaca has a well developed anterior lip. There are 11 pairs of anal papillae; in the largest male the anteriormost papilla lies about 0.4 mm in front of the middle of the sucker and the second only 0.25 mm behind it, but the condition is reversed in a specimen 8.42 mm long. On either side of the cloaca there are three subventral and one lateral papillae. Of the four caudal papillae the first is smallest and lies very close to the second on its anterolateral side; the third is exactly lateral, while the second and fourth are subventral. The two spicules are about 1.12–1.25 mm long. The gubernaculum is 0.138–0.18 mm long.

The vagina is directed forward from the vulva and divides into an anterior and a posterior ovijector lined by conspicuously projecting epithelia. The prominent vulva divides the body length in the ratio of 1.3–1.56 : 1. The oval, thick-shelled eggs containing two blastomeres are 75–84 × 45–51 μ.

DISCUSSION. This species resembles *Cucullanus heterochrous* Rud. of Törnquist from pleuronectids more closely than any other members of the genus from conger eels, but differs from it in the length of the body, esophagus, tail, spicules etc.

Cucullanus robustus n. sp.

SPECIFIC DIAGNOSIS. *Cucullanus* Müller, 1777. Body robust, 7.18 14.5 × 0.4 0.57 mm in male, 13.66–16.0 × 0.4 0.62 mm in female. Tail 0.25 0.3 mm long in male, 0.4–0.44 mm long in female. Cervical papillae a little farther from nerve ring than from hind end of esophagus. Nerve ring 0.4–0.52 mm from head end. False buccal capsule 0.18 0.28 mm broad. Esophagus 0.88–1.41 × 0.138–0.238 mm. Anal papillae 11 pairs in all. Spicules 1.12–1.25 mm long. Gubernaculum 0.138–0.18 mm long. Vulva dividing body length in ratio of 1.3–1.56 : 1. Eggs 75–84 × 45 51 μ, each containing two blastomeres.

Habitat. Intestine of *Conger myriaster*.

Localities. Inland Sea (type locality); Ise Bay.

Dates. August 6, 1926 (type date); April 19, 1929.

Type and paratypes in my collection.

36. *Cucullanus filiformis* n. sp.

DESCRIPTION. This species was found associated with the preceding in the intestine of *Conger myriaster* from the Inland Sea. The slender, almost filiform body, broadest in the posterior part, is up to 17.7 × 0.3 mm in the male and 25.8 × 0.4 mm in the female. The tail, about 0.2 mm long in the male and 0.25–0.38 mm long in the female, is sharply pointed in both sexes. The thin cuticle is very finely striated transversely. The cervical papillae lie just in

front of the posterior end of the esophagus. The excretory pore opens some distance behind the esophagus. The nerve ring lies 0.26–0.35 mm from the head end. Each lateral lip has as usual three small papillae and a narrow denticulate cuticular membrane. The false buccal capsule is 0.125–0.16 mm broad. The esophagus is 0.88–1.0 mm long, just as broad as the buccal capsule, and bears at its posterior end a small appendix projecting into the intestine.

The reflexed anterior end of the testis lies 2.1–2.8 mm behind the esophagus. The epitheliate ductus ejaculatorius is 0.3–0.35 mm long by 0.06–0.075 mm broad and has no bulbous swelling. There are 11 pairs of anal papillae in three groups: the first papilla lies farther in front of the middle of the sucker than the second is behind it (ratio 3 : 2), separated by an interval of 0.38–0.46 mm, and the third lies 0.25 mm behind the second; there are four adanal papillae, one lateral and three subventral, the first of which lies just in front of the anus, the second on the same level with the anus and the third just behind it; of the four caudal papillae the first is very small and lies in front of and between the second, which is lateral, and the third and fourth, which are subventral. The two spicules are 0.98–1.0 mm long. The gubernaculum, 0.108–0.12 mm long, is attenuated and curved at its proximal end.

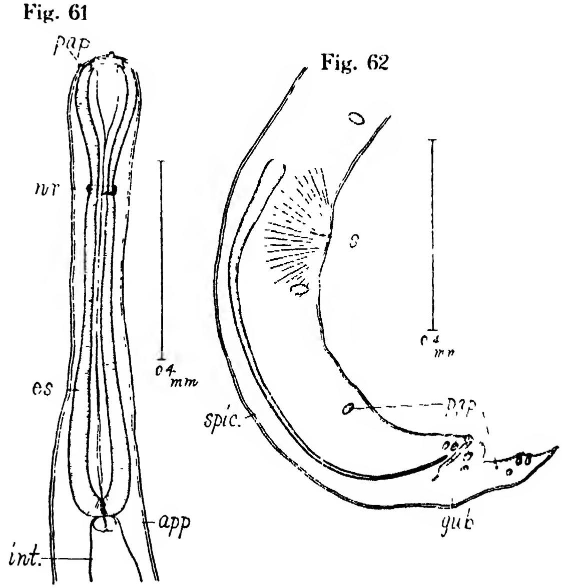


Fig. 61–62. *Cucullanus filiformis.*
Fig. 61. Anterior extremity of female; dorsolateral view.
Fig. 62. Posterior extremity of male; lateral view.

The vagina, 0.27–0.34 mm long, is directed straight forwards from the vulva and then divides into an anterior and a posterior ovijector. The vulva divides the body length in the proportion of 1.8–2.3 : 1. The oval, thick-shelled eggs containing two blastomeres are 66–75 μ long by 39–45 μ broad.

DISCUSSION. This species differs from the most closely allied *Cucullanus incertus* Gendre of Törnquist chiefly in body size and in the host.

Cucullanus filiformis n. sp.

SPECIFIC DIAGNOSIS. *Cucullanus* Müller, 1777; with generic characters. Body filiform, up to 17.7×0.3 mm in male, 25.8×0.4 mm in female. Tail about 0.2 mm long in male, 0.25–0.38 mm in female. Cuticle thin, verp finely striated transversely. Cervical papillae in front of posterior end of esophagus; excretory pore some distance behind it. Nerve ring 0.26–0.35 mm from head

end. False buccal capsule 0.125–0.16 mm broad. Esophagus 0.88–1.0 × 0.125–0.16 mm. 11 pairs of anal papillae. Spicules 0.98–1.0 mm long. Gubernaculum 0.108–0.12 mm long, attenuated and somewhat curved at its proximal end. Vulva dividing body length in proportion of 1.8–2.3:1. Eggs 66–75 × 39–45 μ.

Habitat. Intestine of *Conger myriaster*.

Locality and date. Inland Sea; August. 6, 1926.

Type and paratypes in my collection

37. *Cucullanellus pleuronectidis* n. sp.

Description. This worm is common in pleuronectid fishes from Toyama Bay, the Inland Sea and Mutu Bay. The posteriorly pointed body is up to 8.0 × 0.35 mm in the male and 9.5 × 0.6 mm in the female, and covered by a cuticle 1–5 μ thick. The cervical papillae lie a little in front of the posterior

Fig. 65

Fig. 63

Fig. 64

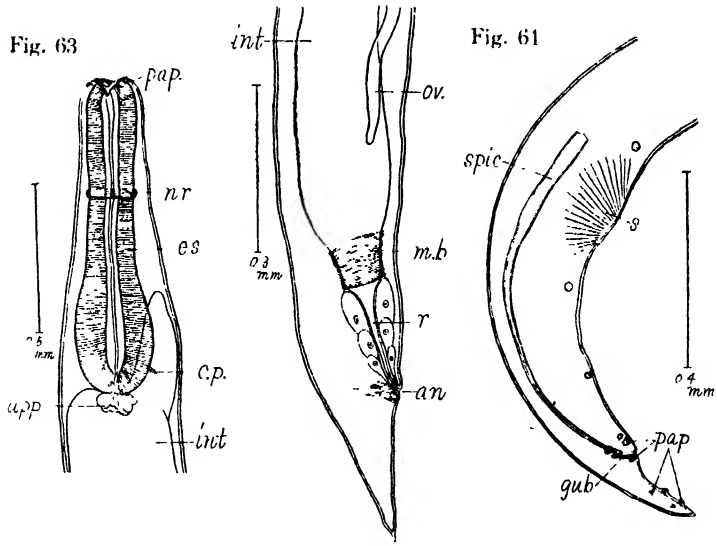


Fig. 63–65. *Cucullanellus pleuronectidis*.
Fig. 63 Anterior extremity of female; dorsal view.
Fig. 64. Posterior extremity of male; lateral view.
Fig. 65. Same of female; lateral view.

end of the esophagus and the tail papillae of the female behind the middle of the tail. The excretory pore lies a little behind the esophagus. The nerve ring lies 0.28–0.46 mm from the head end. Each lateral lip bears on its outer surface three small papillae, the middle of which is very inconspicuous. The mouth is bordered by a narrow denticulate cuticular membrane. The false buccal capsule is 0.13–0.2 mm broad in the male and 0.16–0.22 mm broad in the female. The esophagus is 0.68–0.91 × 0.13–0.25 mm in the male and 0.7–1.12 × 0.15–0.27 mm in the female. There is a lobed appendix projecting from the posterior end of the esophagus into the intestine. The ventral

intestinal cecum, very variable in length, may be 0.38 mm long in the male and 0.53 mm long in the female. Just in front of the rectum the intestine is slightly constricted by a sphincter muscle. The rectum, up to 0.21 mm long and lined by cuticle, is surrounded by a small number of large oval to fusiform cells arranged one behind another. The anus of the female lies 0.2–0.28 mm from the tail end. The cloaca with a prominent papilliform projection on its posterior lip opens 0.13–0.18 mm in front of the tail tip.

The testis beginning some distance in front of the cloaca proceeds forwards and turns back on itself 0.2–0.48 mm behind the esophagus. The ventral sucker lies 0.51–0.65 mm in front of the cloaca. There are 11 pairs of anal papillae in all; the first immediately in front of the sucker, the second about 80 μ* behind it, the third 156 μ behind the second and the fourth 138 μ behind the third; the fourth to seventh lie close together on either side of the anus, while the remaining four form a group near the tail tip; the sixth, eighth and tenth lie more lateral than the others; the eighth which probably corresponds to the tail papilla of the female is so small as to be easily overlooked. The two equal spicules are 0.75–0.87 mm long. The small simple gubernaculum is only 33–48 μ long.

The anterior ovary begins usually 0.13–1.0 mm behind the esophagus and the posterior 0.38–1.38 mm in front of the anus. The muscular vagina, up to 0.8 mm long, is directed backwards. The simple vulva divides the body length in the proportion of 1.3–1.6 : 1. The ellipsoidal, thick-shelled eggs are 69–75 × 42–45 μ; the ova are not segmented.

DISCUSSION. This species resembles *Cucullanellus minutus* (Rud., 1819) of Törnquist more closely than any other known members of the genus, but differs distinctly in body size, in the length of the esophagus, etc. It is distinguished from *Cucullanus heterochrous* Rud., 1802, of Törnquist by the presence of the intestinal cecum, though both agree well in other respects.

Pagrosomus unicolor from the Inland Sea and *Sparus longispinis* from Toyama Bay harbored similar worms, which I prefer to assign for the present to my species.

Cucullanellus pleuronectidis n. sp.

SPECIFIC DIAGNOSIS. *Cucullanellus* Törnquist, 1931; with generic characters. Body up to 8.0 × 0.35 mm in male, 9.5 × 0.6 mm in female. Excretory pore a little behind esophagus. Cervical papillae a little in front of posterior end of esophagus. Nerve ring 0.28–0.46 mm from head end. False buccal capsule 0.13–0.22 mm broad. Esophagus 0.68–1.12 × 0.13–0.27 mm. Tail 0.13–0.18 mm long in male, 0.2-0.28 mm long in female. Anal papillae 11 pairs in all; 4 adanal and 4 caudal; 6th, 8th and 10th lateral. Two spicules 0.75-0.87 mm long. Gubernaculum simple, 33–48 μ long. Vagina up to 0.8 mm long. Vulva dividing body length in ratio of 1.3–1.6 : 1. Eggs 69–75 × 42–45 μ.

Habitat. Intestine of various pleuronectids: *Paralichthys olivaceus* (type host), *Pleuronichthys cornutus*, *Pseudorhombus cinnamomeus*, etc.

Localities. Toyama Bay (type locality); Inland Sea; Mutu Bay.

Dates. January 13, 1928 (type date); June-August, 1927–28.

Type and paratypes in my collection.

*These measurements are from the type.

Literature cited

Törnquist, N. Die Nematodenfamilien Cucullanidae und Camallanidae, 1931, p. 73-90 & 130-171.

Trichuridae Railliet, 1915

38. *Capillaria* sp.

A single female adult was found on September 11, 1927, in the anterior part of the small intestine of *Muraenesox cinereus* from the Inland Sea. It is about 34 mm in length and 0.12 mm in maximum breadth near the posterior end. The nerve ring lies 0.12 mm from the head end. There are no bacillary bands. The para-esophageal cells, about 50 in number, begin about 0.67 mm from the head end. The vulva divides the body length in the ratio of 1 : 2.1. The eggs with polar plugs are 63–66 μ long by 33 μ broad.

The specific determination of this worm can not be made until male adults are obtained.

39. *Hepaticola* sp.

Eggs of a *Hepaticola* sp. were found closely massed together as brownish grey spots in the liver of *Scomber japonicus*. They lie in the acini of the liver or in the interlobular septa, causing an atrophy or necrosis of the surrounding parenchymatous cells. The outer shell, striated in optical section, measures 54–63 × 24–27 μ; the inner chitinous one is thick. The contained ova are not yet segmented.

Abbreviations used in Figures

an. anus
app. appendix
b. c. buccal capsule
b. t. boring tooth
c. p. cervical papilla
cut. cuticula
d. ej. ductus ejaculatorius
d. l. dorsal line
e. embryos
es. esophagus
es. gl. esophageal gland
ex. p. excretory pore
g. c. germ cells
g. d. germiduct
gl. c. gland cells
gl. d. gland duct
gl. es. glandular esophagus
g. p. genital pore
gub. gubernaculum
h. hook
hyp. hypodermis
i. l. interlabium
int. intestine
l. f. lateral field
l. l. lateral lip
m. muscles
m. b. muscular band
m. c. mouth cavity
m. es. muscular esophagus
n. r. nerve ring
ov. ovary
ovj. ovijector
pap. papillae
r. rectum
r. s. receptaculum seminis
s. sucker
sperm. spermatozoa
spic. spicules
sub. l. subventral lips
test. testis
ut. uterus
v. vulva
vag. vagina
ventr. ventriculus
vest. vestibule
v. l. ventral line
v. s. vesicula seminalis

11. Studies on the Helminth Fauna of Japan
Part 10. Amphibian Nematodes

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CONTENTS

INTRODUCTION

Morishita (1926) and Wilkie (1930) have sufficiently worked out the nematode parasites of common Japanese amphibians, with the exception of an oxyurid usually parasitic in the cecum of frogs and newts. Although this worm is one of the commonest amphibian nematodes, the male is as yet unknown, so that I have also omitted this species from the present paper.

With the addition of two new species described in this paper the known amphibian nematodes of Japan now amount to 14 species, though a few of them are somewhat doubtful.

HETERAKIDAE Railliet et Henry, 1914

1. *Spinicauda japonica* Wilkie, 1930

Five male and as many female adults were found in the small intestine of *Bufo vulgaris japonicus* Schlegel from Sirahama, Wakayama Prefecture. They measured in mm as follows.

Body 3.95–4.5 × 0.21–0.24 in the male, 5.2–6.6 × 0.26–0.4 in the female;

pharynx 0.06–0.078 × 0.021–0.042 ; esophagus including posterior bulb 0.75–1.05 × 0.14–0.2 ; nerve ring 0.3–0.37 from head end ; excretory pore 0.46–0.58 from head end ; tail 0.25–0.3 in the male, 0.38–0.43 in the female ; spicules 0.48–0.54 ; preanal sucker 0.044–0.051 in diameter ; eggs 0.072–0.086 × 0.042–0.051.

The three oral lips have each two inconspicuous papillae on the outer side and one sharp, anteriorly directed tooth on the inner. The excretory duct is surrounded at its opening by a rosette-shaped vesicle in all the specimens examined. The anal papillae, especially the smallest anterior ones, are variable in number; 14 preanals and 6 postanals have been counted. Wilkie's statement that there are three preanal pairs of large fleshy papillae is obviously erroneous, because only two of them are shown in his figure 4 and I have also seen only two. One of the adanal papillae is very large, as described and figured by Wilkie. In addition to the two constantly occurring subdorsal and one ventral postanal pairs, there are one or two small lateral and one large conical ventral pairs, the latter lying immediately behind the anus.

The vulva divides the body length in the ratio of 1 : 1.3–1.7. The ellipsoidal, thick-shelled eggs as fixed in alcohol and measured in water are 72–86 μ long by 42–51 μ broad.

Fig. 2

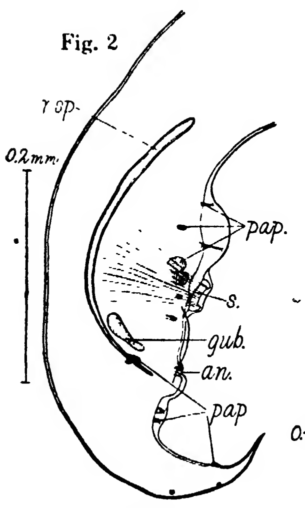

Fig. 1

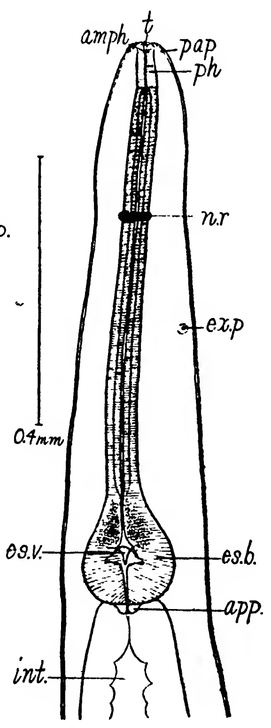

Fig. 1–2. *Spinicauda bufonis.*
Fig. 1. Anterior extremity of female; lateral view.
Fig. 2. Posterior extremity of male; lateral view.

2. *Spinicauda bufonis* n. sp.

A number of this nematode were collected by Mr. Ukyô Ô at Tainan from the large intestine of *Bufo melanostictus* Schneider. It differs from *S. japonica* Wilkie, 1930, chiefly in the length of spicules and in the size of eggs, but the resemblance is so marked that a detailed account of it will be unnecessary. The preanal papillae, especially the anteriormost ones, are somewhat variable in number but up to 9 pairs have been counted, of which two are large and fleshy and lie at the level of the preanal sucker. The pair directly in front of the anus is comparatively inconspicuous, but the adanal one is very large and fleshy. Immediately behind the anus there are usually two pairs of small submedian papillae, and a similar pair lies near the tail tip. In addition to these, there are two pairs

of minute lateral papillae, one at the level of the posterior submedian papillae and the other some distance in front of it.

SPECIFIC DIAGNOSIS. *Spinicauda* Travassos, 1920. Male 4.0–4.9×0.2–0.28 mm; tail 0.15–0.21 mm. Female 5.0–6.4×0.3–0.36 mm; tail conical, pointed, 0.24–0.33 mm. Nerve ring 0.25–0.36 mm from head end. Excretory pore 0.4–0.56 mm from head end. Pharynx 48–60×33–42 μ. Esophagus 0.67–0.95 mm long, including posterior bulb 0.11–0.16 mm broad. Spicules 0.18–0.21 mm long. Preanal sucker 38–42 μ in diameter. Eggs elliptical, thick-shelled, containing a vacuole at each pole, 68–75×40–45 μ.

Habitat. Large intestine of *Bufo melanostictus* Schneider.

Locality and date. Tainan, Formosa; October 28, 1934.

Type and paratypes in my collection.

RHABDIASIDAE Railliet, 1915

3. *Rhabdias nipponica* n. sp.

This species has been confused by Morishita with *Rhabdias bufonis* (Schrank, 1788), but is markedly different in body size. It rather resembles *R. ranae* Walton, 1929, but differs distinctly in the structure of the mouth, the size of eggs, etc., as may be seen from the following diagnosis.

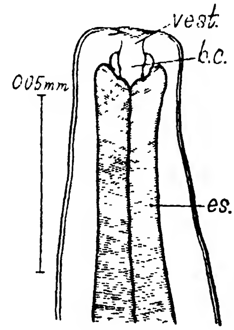

Fig. 3. Anterior extremity of *Rhabdias nipponica*; lateral view.

SPECIFIC DIAGNOSIS. *Rhabdias* Stiles et Hassall, 1905. Body 4.18–5.04×0.17–0.19 mm. Mouth without papillae. Vestibule 7–9 μ long. Buccal capsule thick-walled, 9–12 μ long, with a slight transverse constriction behind its middle. Esophagus elongate club-shaped, 0.26–0.31 mm long. Nerve ring 0.12–0.14 mm and excretory pore 0.17–0.18 mm, from head end. Vulva dividing body length in ratio of 1.02–1.19:1. Eggs ellipsoidal, thin-shelled, embryonated, 84–102×45–57 μ as measured on specimens mounted in glycerine-gelatine, 95–100×36–53 μ in life, 78–89×39–53 μ as fixed in alcohol and measured in water.

Habitat. Lungs of *Rana rugosa* (type host), *R. nigromaculata*.

Locality. Kyoto.

Type and paratypes in my collection.

4. *Rhabdias tokyoensis* Wilkie, 1930

This species is common in the Japanese newt, *Diemyctylus pyrrhogaster* (Boie). Measurements on six mature specimens are as follows.

Body 8.44–11.68×0.37–0.5 mm. Buccal capsule 16–27 μ long by 21–27 μ broad. Esophagus 0.56–0.61 mm long. Tail 0.21–0.25 mm long. Vulva dividing body length in ratio of 1.0–1.26:1. Eggs 99–126×48–62 μ.

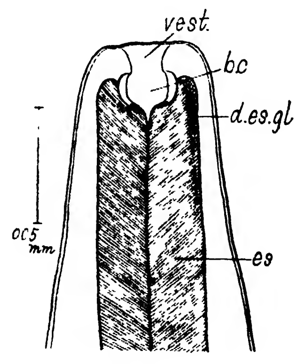

Fig. 4. Anterior extremity of *Rhabdias tokyoensis* Wilkie, 1930; lateral view.

The esophagus contains at the anterior end an elongate dorsal esophageal gland, whose duct appears to open on the dorsal side into the vestibule at the anterior margin of the buccal capsule.

I have found a larva of this species in the

body cavity of a newt and some in the intestine. The measurements under A refer to the former and those under B to the latter.

A. Body 5.65 mm long, buccal capsule 15–16 μ long, esophagus 0.518 mm long, pointed tail 0.12 mm long, vulva dividing body length in ratio of 4 : 3.

B. Body 5.23–6.31 mm long, buccal capsule 16–18 μ long, esophagus 0.56–0.58 mm long, tail 0.18–0.24 mm long, vulva dividing body length in ratio of 1.04–1.33 : 1.

It is to be noted that the measurements of the specimen from the body cavity agrees almost exactly with those of *R. escheri* Baer, 1930, from the body cavity of the Indian newt *Uroeotyphlus oxyurus*.

TRICHOSTRONGYLIDAE Leiper, 1912

5. *Amphibiophilus socialis* (Morishita, 1926) n. comb.

A comparison of my specimens from *Rana japonica* with Morishita's original description revealed a serious error on his part, which led him to emend the genus *Oswaldocruzia* Travassos and create a new subgenus *Bialata* for *bialata* (Molin), *subventricosa* Schneider and his own three new species, *insulae*, *socialis* and *yezoensis*. Morishita has undoubtedly overlooked the prominent dorsal triangular denticle of the buccal cavity, characteristic of the genus *Amphibiophilus* Skrjabin, 1916. The type of this genus, *A. acanthocirratus*, has a cuticular thickening at the head and two lateral alae beginning a little behind it, as in *socialis*; other characters agree well with those of the latter species, though some minor differences are found in the dorsal ray and the spicules. That a true gubernaculum is present seems doubtful. I venture therefore to refer Morishita's species to *Amphibiophilus* Skrjabin, which belongs to Amidostominae Travassos, 1919.

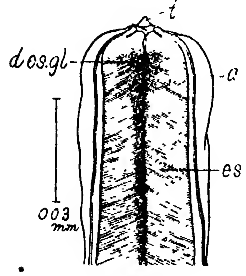

Fig. 5. Anterior extremity of male *Amphibiophilus socialis* (Morishita, 1926); ventral view.

In my specimens (5 males and 7 females) the body is 5.8–8.5 × 0.13–0.21 mm in the male and 10.05–11.05 × 0.18–0.27 mm in the female. They are slightly different from Morishita's specimens in that the spicules are 0.18–0.21 mm long and the tail length of the female is 0.1–0.14 mm. The vulva divides the body length in the ratio of 1.5–2.1 : 1. The ellipsoidal, thin-shelled eggs as fixed in alcohol and measured in water are 66–81 μ long by 39–48 μ broad ; the contained ova are segmented but not embryonated.

HEDRURIDAE Railliet, 1916

6. *Hedruris ijimai* Morishita, 1926

Three males and seven females were found in the small intestine of *Rana nigromaculata* and *R. rugosa*. The principal measurements in mm are as follows.

Body 8.7–11.8 × 0.18–0.28 in male, 9.65–11.88 × 0.28–0.31 in female; esophagus 0.95–1.21 × 0.088–0.12; cervical papillae 0.31–0.35 from head end; excretory pore 0.12–0.15 from head end; tail 0.39–0.15 in male, 0.27–0.38 in female; spicule 0.15–0.195; vulva 0.62–1.0 from tail end, dividing body length in ratio of 9.7–15.7 : 1; fully developed embryonated eggs as fixed in alcohol and measured in water 0.039–0.046 long by 0.025–0.03 broad at level of lateral protuberances.

It is to be noted that in my material the eggs are not over 0.03 mm broad, whereas in Morishita's they are 0.03–0.035 mm broad.

GNATHOSTOMATIDAE Nicoll, 1927

7. *Spiroxys japonica* Morishita, 1926

On the basis of a comparative study of my material from *Rana rugosa* with Morishita's detailed description I want to make here a brief supplementary note.

The muscular esophagus contains a glandular tissue throughout, except for a short distance at its anterior end.

According to Morishita the vulva opens on a cone a little behind the middle of the body, but to be more accurate it divides the body length in the ratio of 1.8–2.5 : 1. The subglobular to elliptical, thin-shelled eggs as fixed in alcohol and measured in water vary from 58 μ to 84 μ in length and from 42 μ to 60 μ in breadth. Though not recognizable in life, there is after fixation a considerable space between the shell and the ovum, which is in various stages of segmentation.

Fig. 6. Transverse section of female *Spiroxys japonica* (Morishita, 1926) showing excretory pore.

TRICHURIDAE Railliet, 1915

8. *Capillaria bufonis* Morishita, 1926

A number of gravid females were found in the small intestine of *Diemyctylus pyrrhogaster* from Kyoto. The body is 9.77–13.12 × 0.08–0.1 mm;

the esophagus is 3.8–5.3 mm long; the vulva divides the body length in the ratio of 1 : 1.1–1.54; the eggs are 63–72 × 30–35 μ in whole mounts.

Wilkie says that the specimens from *Triturus pyrrhogaster*, *Hynobius stejnegeri* and *H.* sp. are referable to *Capillaria filiformis* (v. Linst., 1885), but none of my specimens from the newt has bacillary bands characteristic of Linstow's species.

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Abbreviations used in Figures

a. ala
amph. amphid
an. anus
app appendix
b. c. buccal capsule
d. es. gl. dorsal esophageal gland
es. esophagus
es. b. esophageal bulb
es. v. esophageal valve
ex. p. excretory pore
gub. gubernaculum
n. r. nerve ring
int intestine
pap. papilla
ph. pharynx
r. sp right spicule
s. sucker
t. tooth
vest. vestibule

12. Studies on the Helminth Fauna of Japan
Part 11. Reptilian Nematodes

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Laboratory of Parasitology, Kyoto Imperial University

CONTENTS

INTRODUCTION

The seven nematode species from Japanese reptiles so far examined are new to science with the exception of two, one of which has been reported from China and the other has been left unidentified owing to lack of material. The five new species described in this paper belong to four known genera of different families. I am indebted to Mr. Ukyô Ô of Tainan Normal School for the material from *Japalura swinhonis*.

ASCARIDAE Baird, 1853

1. *Ophidascaris natricis* n. sp.

DESCRIPTION. This nematode occurs usually in the small intestine of *Natrix tigrina* and less frequently in that of *Elaphe quadrivirgata*. The body is up to about 100 × 1.2 mm in the male and 170 × 2.5 mm in the female, and covered by a thick smooth cuticle. The head is 0.25–0.41 mm broad and only slightly constricted off from the body. The almost square lips, 0.14–0.2 mm long by 0.16–0.23 mm broad, are finely denticulated along the anterior margin; the dorsal lip bears two double papillae but the subventral one a single double

papilla and an amphid. There are no true interlabia or transverse grooves at the base of the lips. The nerve ring and the cervical papillae lie at about the same level, 0.7–1.0 mm from the head end. The excretory duct opens just behind the nerve ring. The esophagus, 3.4–5.6 mm long, is divided at the anterior end into three lobes, each of which bears in front two very small papillae and projects forwards on the inner side of each lip. The digitiform tail is 0.23–0.27 mm long in the male and up to 0.45 mm long in the female. There are on either side about 60, somewhat irregularly arranged preanal and 5 postanal papillae; the anteriormost postanal has a double nerve ending and the other four are grouped near the tail end. There is a flat papilliform elevation of the pulp on the dorsal side of the tail tip. The two spicules are up to about 1.3 mm long.

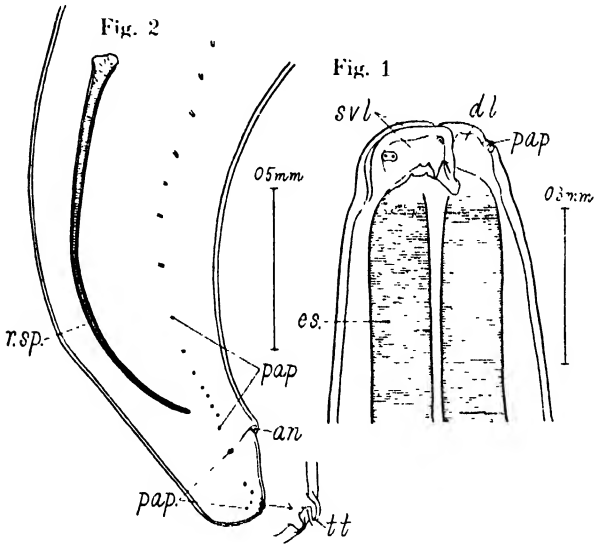

Fig. 1–2. *Ophidascaris natricis.*
Fig. 1. Anterior extremity of male; lateral view.
Fig. 2. Posterior extremity of male; lateral view.

The vulva lies in the posterior half of the middle third of the body. The subglobular to oval, extremely thick-shelled eggs with reticulate surface are 90–102 μ long by 72–90 μ broad, and contain segmented ova.

Discussion. This species differs from the closely allied *Ophidascaris excavata* Hsü et Hoeppli, 1931, and *O. baylisi* Robinson, 1934, in the absence of transverse grooves at the base of the lips and in other important characters. The "internal lip papillae" of Hsü and Hoeppli are found in my species on the top of the three anterior lobes of the esophagus.

Ophidascaris natricis n. sp.

Specific Diagnosis. *Ophidascaris* Baylis, 1921. Male up to 100×1.2 mm; female up to 170×2.5 mm. Head 0.25–0.41 mm broad. No interlabia. No transverse grooves at base of lips. Esophagus 3.4–5.6 mm long. Tail digitifom, 0.23–0.27 mm long in male, up to 0.45 mm long in female. Preanal papillae ca. 60 pairs, postanal ones 5 pairs. Spicules up to 1.3 mm long. Vulva in posterior half of middle third of body. Eggs subglobular to oval, 90–102×72–90 μ.

Habitat. Small intestine of *Natrix tigrina* (type host) and *Elaphe quadrivirgata*..

Locality and date. Wakayama Prefecture; July 20, 1926.

Type and paratypes in my collection.

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Robinson, V. C. On a collection of parasitic worms from Malay. I. Nematodes (Superfamilies Ascaroidea and Oxyuroidea). Parasit., Vol. 26, No. 4, 1934, p. 482–483.

HETERAKIDAE Railliet et Henry, 1914

2. *Ascaridia japalurae* n. sp.

DESCRIPTION. Five male and three female adults were collected by Mr. Ukyô Ô of Tainan Normal School from the cloaca of *Japalura swinhonis* Günther in Formosa. The body, with finely cross-striated cuticle, is 8.6–9.1 × 0.21–0.26 mm in the male and 9.8–11.9 × 0.28–0.3 mm in the female. The head, only slightly constricted off from the body, is only 47–50 μ broad in the male but 56–61 μ broad in the female at the level of the lip papillae, whence it tapers rapidly toward the anterior end. The three lips have each two papillae. The cylindrical pharynx is 0.17–0.18 mm long in the male and 0.21–0.24 mm long in the female. The esophagus, 1.3–1.5 mm long in the male and 1.5–1.8 mm long in the female, forms at its posterior end a large bulbous swelling, 0.21–0.28 mm in diameter and containing a chitinous trivalvular apparatus. The simple intestine is conspicuously enlarged at the beginning, and the epithelium is usually dotted throughout with dark brown pigment granules. The abruptly conical tail with a pointed tip is 75–112 μ long in the male and 0.23–0.28 mm long in the female.

Fig. 3

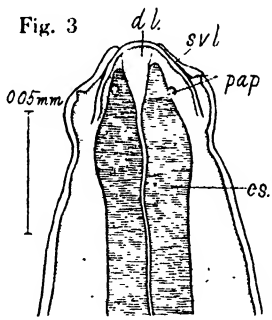

Fig. 4

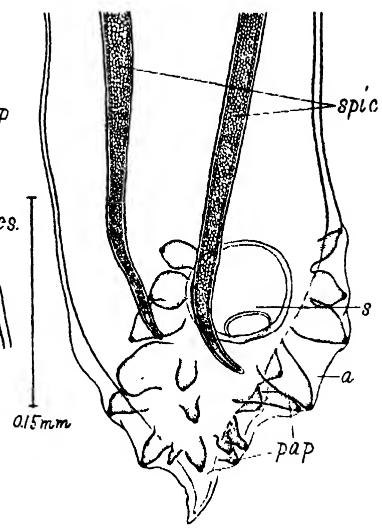

Fig. 3–4. *Ascaridia japalurae*.
Fig. 3. Anterior extremity of female; dorsal view.
Fig. 4. Posterior extremity of male; dorsal view.

The prominent hollow sucker, 60–70 μ in diameter and with a chitinous border, lies immediately in front of the cloacal aperture. The caudal alae are not well developed. There are 10 pairs of large stout pedunculate anal papillae, three on either side of the sucker and the other seven behind it.

The two simple hollow spicules, with wall like pavement, are 0.64–0.68 mm long.

The more or less prominent vulva divides the body length in the proportion of 1.4–1.76 : 1. The ellipsoidal, thick-shelled eggs are 81–89 × 41–47 ; the contained ova are segmented.

This is the first *Ascaridia* species described from *Japalura.*

Ascaridia japalurae n. sp.

SPECIFIC DIAGNOSIS. *Ascaridia* Dujardin, 1845. Male 8.6–9.1 × 0.21–0.26 mm, female 9.8–11.9 × 0.28–0.3 mm. Head 47–61 μ broad at level of papillae, thence tapering rapidly forward. Pharynx 0.17–0.24 mm long. Esophagus 1.3–1.8 mm long; bulb 0.21–0.28 mm in diameter. Tail 0.075–0.112 mm long in male, 0.23–0.28 mm in female. Sucker prominent, hollow, 60–70 μ in diameter. Caudal papillae large, pedunculate, in 10 pairs (3 beside sucker, 7 behind it). Spicules 0.64–0.68 mm long. Vulva dividing body length in ratio of 1.4–1.76:1. Eggs ellipsoidal, with segmented ova, 81–89 × 41–47 μ.

Habitat. Cloaca of *Japalura swinhonis* Günther.

Locality and date. Formosa; August 16, 1932.

Type and paratypes in my collection.

KATHLANIIDAE (Travassos, 1918)

3. *Spironoura japonensis* n. sp.

DESCRIPTION. Of the ten mature specimens on which the following description is based, five males were obtained from the gall bladder of *Clemmys japonica* Temm. et Schleg. and the other five, all females, from the small and large intestines of another individual of the same species. Further, two mature and fourteen young specimens apparently of the same species were found in the large intestine as well as in the terminal part of the small intestine of *Geoclemmys reevesii* (Gray). The body, with very finely cross-striated cuticle, is 7.5–10.0 × 0.25–0.28 mm in the male and 10.4–11.5 × 0.35–0.45 mm in the female. The head is 0.1–0.12 mm broad and continued into the body without any demarcation. The sharply pointed tail is 0.39–0.46 mm long in the male and 0.72–0.87 mm in the female. The excretory duct with longitudinal striations at the distal end opens 0.9–1.0 mm from the head end. The cervical papillae lie some distance in front of the excretory pore. The nerve ring lies 0.28–0.35 mm from the head end.

The three lips of the mouth bear each two outer and two inner papillae; the stalked pulp of the outer papilla unites at the base with that of the inner papilla, so that in profile it appears bifurcate. The thick-walled pharynx is 48–60 μ long by 54–78 μ broad. The cylindrical part of the esophagus is 1.06–1.2 mm long. The anterior swelling of the hour-glass-shaped esophageal bulb is 88–111 μ in diameter and the posterior one with a trivalvate apparatus and a similar posterior appendix is 0.15–0.2 mm in diameter. The rectum is very wide.

There are three pairs of large conspicuous papillae in front of the cloacal

aperture, one median papilla on its anterior border and three slightly smaller ones on either side. Of the 5 postanal papillae, the first three are lateral and the rest subventral. The broadly alate spicules, 1.2–1.3 mm long, have each on the ventral side 15–25 small pointed teeth forming a series with somewhat irregular intervals. The gubernaculum is 0.13–0.138 mm long. The anterior

Fig. 5

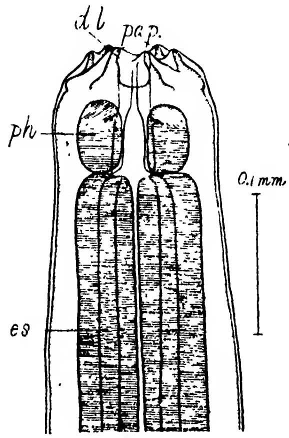

Fig. 6

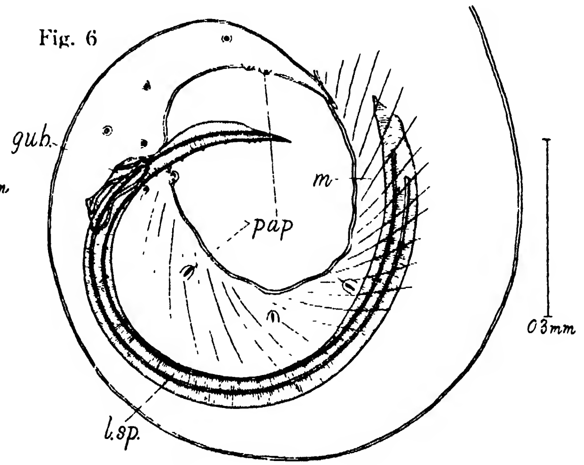

Fig. 5-6. *Spironoura japonensis.*
Fig. 5. Anterior extremity of female; dorsal view.
Fig. 6. Posterior extremity of male; lateral view.

transverse and the posterior oblique muscular bands of the precloacal region are well developed, the former sometimes massed into one or two sucker-like organs.

The long cylindrical muscular vagina is directed anterodorsad from the vulva, which divides the body length in the ratio of 1.3–1.6 : 1. The elongate oval, thick-shelled eggs as fixed in alcohol and measured in water are 84–99 μ long by 54–63 μ broad; the contained ova are not segmented.

Discussion. This species is characterized by the possession of a series of small teeth on the ventral side of the spicule. Karve's division of the known sixteen species into two groups, the one with one or more preanal sucker-like organs, and the other without any, does not apply to the present species.

Spironoura japonensis n. sp.

Specific Diagnosis. *Spironoura* Leidy, 1856. Male 7.5–10.0 × 0.25–0.28 mm, including tail 0.39–0.46 mm long; female 10.4–11.5 × 0.35-0.45 mm, inclusive of tail 0.72–0.87 mm long. Head 0.1–0.12 mm broad. Excretory pore 0.9–1.0 mm from head end. Nerve ring 0.28–0.35 mm from head end. Pharynx 48–60 × 54–78 μ. Cylindrical part of esophagus 1.06–1.2 mm long; anterior swelling of esophageal bulb 88–111 μ in diameter, posterior one 0.15–0.2 mm in diameter. With one median and 11 paired anal papillae. 1–2 precloacal sucker-like organs sometimes present. Spicules with a series of 15–25 small pointed teeth on ventral side, 1.2–1.3 mm long. Gubernaculum 0.13-0.138 mm long. Vulva dividing body length in ratio of 1.3–1.6:1. Eggs 84–99 × 54–63 μ.

Habitat. Gall bladder, small and large intestines of *Clemmys japonica* Temm. et Schleg. (type host) and *Geoclemmys reevesii* (Gray).
Localities. Suburbs of Kyoto (type locality); Hyôgo Prefecture.
Type and paratypes in my collection.

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DIAPHANOCEPHALIDAE Travassos, 1919

4. *Kalicephalus laticaudae* n. sp.

DESCRIPTION. Two male and three female adults were found in the small intestine of *Laticauda laticaudata* from Isigaki Zima. The slender cylindrical body is 7.1–7.84 × 0.25–0.28 mm in the male and 9.6–10.1 × 0.28 mm in the female. The laterally flattened head, slightly constricted off from the body, measures 0.168–0.21 mm dorsoventrally at the front end. Each lateral valve of the buccal capsule has three longitudinal parenchymatous bands. The bottle-shaped muscular esophagus containing scanty glandular tissue is 0.36–0.42 mm long and 0.18–0.21 mm broad at the swollen posterior part with an inconspicuous appendix projecting into the intestine. The nerve ring lies at the narrowest part of the esophagus, 0.29–0.35 mm from the head end. The two elongate unicellular gland-like bodies containing fine granules (so-called "cervical gland") extend backwards from just behind the excretory pore lying at the level of the posterior end of the esophagus, first on the ventral side of the intestine, then lateral to it. The pointed tail of the female is 0.36–0.38 mm long.

Fig. 8

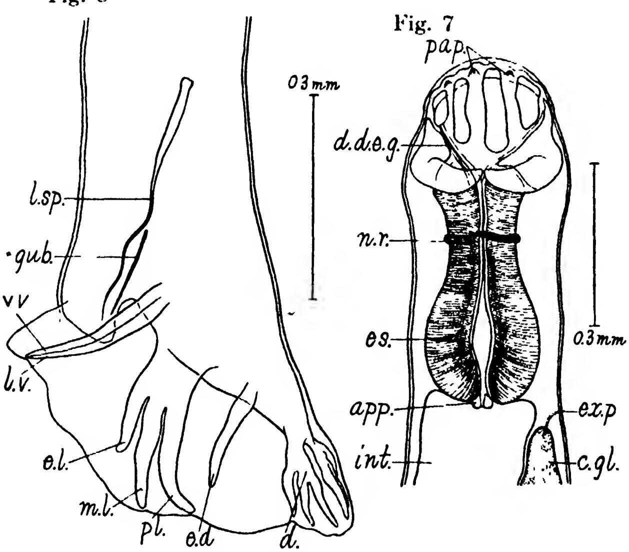

Fig. 7–8. *Kalicephalus laticaudae.*
Fig. 7. Anterior extremity of female; lateral view.
Fig. 8. Posterior extremity of male; lateral view.

The two slender spicules, undulating posteriorly, are 0.33–0.37 mm long. The gubernaculum is about 0.15 mm long. The genital cone is prominent but does not protrude beyond the bursa, in front of which there is no dorsal hump.

The bursa is short and campanulate, with a slight indication of a dorsal lobe; the rays are shown in fig. 8.

The very prominent vulva divides the body length approximately in the ratio of 1.5 : 1. The ellipsoidal, thin-shelled eggs are 84–98 μ long by 50–61 μ broad; there is a fairly wide free space around the segmented ovum.

This is the first *Kalicephalus* species that has been described from a sea snake.

Kalicephalus laticaudae n. sp.

SPECIFIC DIAGNOSIS. *Kalicephalus* Molin, 1861. Male 7.1–7.8 × 0.25–0.28 mm, female 9.6–10.1 × 0.28 mm. Head end measuring 0.168–0.21 mm dorsoventrally. Spicules 0.33–0.37 mm long. Gubernaculum 0.15 mm long. Ventral rays cleft; externolateral and laterals arising from a common trunk; mediolateral and posterolateral separated; dorsal immediately divided into two branches, which subdivide each into a simple outer prong reaching to the incision demarcating dorsal lobe of bursa and a bifurcate inner prong with a simple pointed end. Vulva dividing body length in ratio of 1.5:1. Eggs ellipsoidal, thin-shelled, 84–98 × 50–61 μ as fixed in alcohol and measured in water.

Habitat. Small intestine of *Laticauda laticaudata*.

Locality and date. Isigaki Zima; July, 1930.

Type and paratypes in my collection.

5. *Kalicephalus natricis* n. sp.

DESCRIPTION. This species is common in *Natrix tigrina* and *Elaphe quadrivirgata*. The smooth body is 4.7–11.2 × 0.25–0.15 mm in the male and 12–14.3 × 0.45–0.55 mm in the female. The buccal capsule, supported on either side by three longitudinal parenchymatous bands, measures 0.12–0.28 mm deep and 0.13–0.28 mm broad dorsoventrally at the level of the widest lumen. The nerve ring lies 0.22–0.45 mm from the head end. The musculo-glandular esophagus is 0.3–0.52 mm long by 0.13–0.21 mm broad at its posterior swelling. The excretory pore lies 0.27–0.51 mm from the head end. The pointed tail of the female is 0.21–0.43 mm long.

The short thick dorsal ray of the bursa divides into two branches which immediately subdivide each into a simple outer and a bifid inner twig. The genital cone with the cloacal aperture on its tip does not protrude beyond the campanulate bursa. The two slender spicules are 0.32–0.45 mm long. The spatulate gubernaculum is 0.15–0.18 mm long.

The proximal end of the posterior uterus lies usually in front of the vulva but sometimes behind it, so that Ortlepp's division of the genus into Group A with divergent uteri and Group B with convergent uteri is not applicable to this species. The prominent vulva divides the body length in the ratio of 1.6–3.0 : 1. The ellipsoidal, thin-shelled eggs are 70–75 μ long by 43–48 μ broad; the contained ovum is in the morula stage.

DISCUSSION. This species resembles *K. agkistrodontis* Harwood, 1932, more closely than any other known members of the genus, but differs from it chiefly in the length of the spicules and in the position of the vulva.

Fig. 9

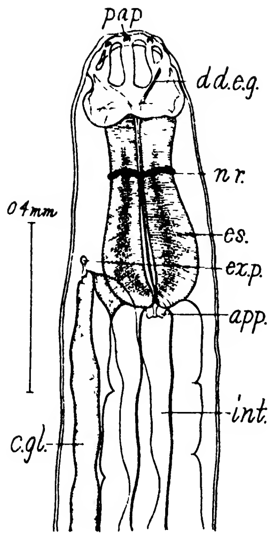

Fig. 10

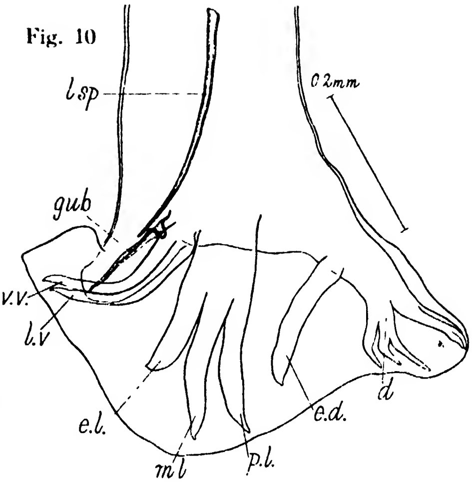

Fig. 11

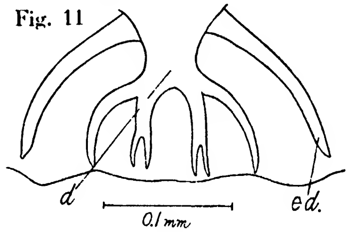

Fig. 9–10 *Kalicephalus natricis.*
Fig. 9. Anterior extremity of male; lateral view.
Fig. 10. Posterior extremity of male; lateral view.
Fig. 11. Dorsal lobe of same; dorsal view.

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Camallanidae Railliet et Henry, 1915

6. *Camallanus intermedius* Hsü et Hoeppli, 1931

A number of young and adults were collected from the small intestine of *Geoclemmys reevesii* (Gray) at Tarumi. The body, with very fine transverse striations, is 6.6–8.5 × 0.2–0.25 mm in the male and 12.3–17.8 × 0.3–0.37 mm in the female. The head, measuring 0.14–0.18 mm dorsoventrally, has one lateral and two submedian papillae on the anterior border of each buccal valve. The neck widens rapidly into a well marked shoulder at its junction with the body. The nerve ring and the cervical papillae lie 0.2–0.24 mm and 0.44–0.53 mm respectively from the anterior extremity, with the excretory pore between. The tail of the male is 0.11–0.12 mm long and has a bifid tip, while that of the female is 0.2–0.32 mm long and terminates in three points.

Each buccal valve, 0.1–0.13 mm long, has two internal chitinoid thickenings on the anterior border and 4–5 (usually 5) longitudinal ridges on the inner surface. The chitinous ring between the buccal valves and the esophagus is about 90–100 μ in diameter. The three prongs of the trident are 60–90 μ long; the median prong is pointed in side view but the outer ones are blunt. The anterior muscular portion of the esophagus is 0.41–0.48 mm long and the posterior granular portion, with a small valvular appendix, 0.5–0.68 mm long.

The caudal alae of the male are continuous in front across the ventral surface. There are seven pairs of pedunculate preanal, five pairs of similar postanal and one pair of very small lateral papillae, the latter near the tip of the tail. In addition to these there are four para-anal papillae, two on the anterior border and two on the posterior. Of the first three postanals which are very close together, one is directly lateral to and longer than the other two. The fourth postanal papilla is anteromedial or medial to and longer than the fifth and farther from it than the fourth is from the third, so that the subventral postanals may be divided into two groups. The right spicule, 0.61 mm long in a specimen 6.6 mm long, has an S-shaped terminal prong about 36 μ long, and a dorsal barb at its base; the left spicule is not present even in the largest examples at hand, so that it appears to develop only when full sexual maturity is reached.

The vulva, with a larger and more prominent anterior lip than the posterior, divides the body length in the ratio of 1 : 0.86–1.37, usually lying a little behind the middle of the body. The fully developed embryos are up to 0.37 mm long and 15 μ broad.

As compared with the examples of Hsü and Hoeppli the female specimens at my disposal are definitely larger, but a close comparison with the original description shows that my examples of both sexes agree well with the Chinese originals, in which the measurements for the tail of the male and for the position of the vulva are erroneously given, as is evident from the text and the plate-figures 13 and 23.

It is to be noted that in this species as well as in *C. americanus* Magath, 1919, the longitudinal ridges of the buccal valve are not constant in number, whereas in *C. octorugatus* Baylis, 1933, they are always 8.

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TRICHURIDAE Railliet, 1915

7. *Capillaria* sp.

DESCRIPTION. Eight gravid females were obtained from the small intestine of *Elaphe quadrivirgata*. The body, with very fine transverse striations, is 9.9–13.5 mm long by 0.09–0.12 mm broad. There are no bacillary bands. The inconspicuous nerve ring lies 66–81 μ from the anterior extremity. The esophagus is 3.8–4.6 mm long. The anus is subterminal. The vagina is 0.15–0.18 mm long. The vulva, dividing the body length in the proportion of 1 : 1.6–1.94, lies 20–60 μ behind the anterior end of the intestine. The lemon-shaped eggs are 69–72 μ long by 30–33 μ broad; the outer shell is striated in optical section.

The specific identification of this worm is reserved until male adults are obtained.

ABBREVIATIONS USED IN FIGURES

a. ala
an. anus
app. appendix
d. dorsal ray
d. d. es. gl. duct of dorsal esophageal gland
d. l. dorsal lip
c. gl. so-called cervical gland
e. d. externodorsal ray
e. l. externolateral ray
es. esophagus
ex. p. excretory pore
gub. gubernaculum
int. intestine
l. sp. left spicule
l. v. lateroventral ray
m. muscle
m. l. mediolateral ray
n. r. nerve ring
pap. papilla
ph. pharynx
p. l. posterolateral ray
r. sp. right spicule
s. sucker
spic. spicule
s. v. l. subventral lip
t. t. tail tip
v. v. ventroventral ray

Studies on the Helminth Fauna of Japan

Part 12. Avian Nematodes, I

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Laboratory of Parasitology, Kyoto Imperial University

CONTENTS

INTRODUCTION

Thirteen new nematodes belonging to ten genera have been obtained from Japanese birds dissected so far, including a new type of Filariidae. Numerous species reported from other countries also occur, as is natural from the migratory habit of many of the hosts.

I wish to express here my sincere thanks to Mr. Ukyô Ô of Tainan Normal School for giving me three new Formosan nematodes.

ASCARIDAE Baird, 1853

1. *Contracaecum microcephalum* (Rud., 1809) Baylis, 1920

Numerous male and female adults of this species were taken on August 20, 1929, from the esophagus and stomach of *Nycticorax nycticorax nycticorax*.

Fig. 2

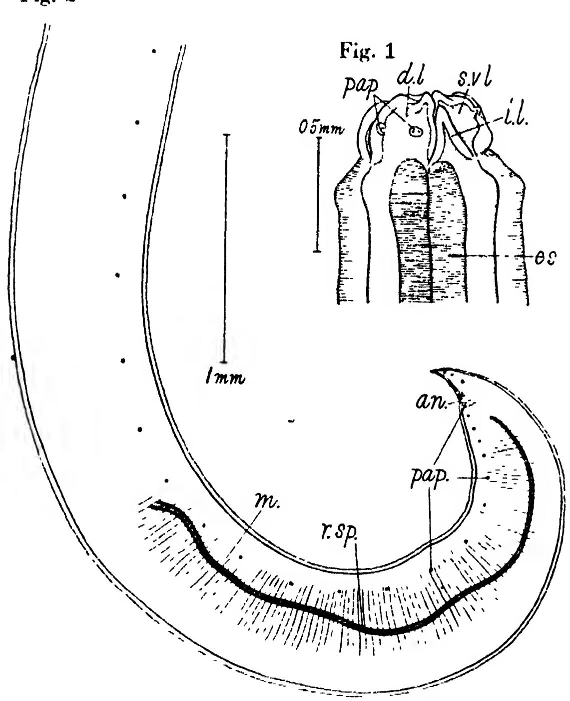

Fig. 1-2. *Contracaecum microcephalum* (Rud., 1809).
Fig. 1. Anterior extremity of female; dorsolateral view.
Fig. 2. Posterior extremity of male; lateral view.

The following note is to supplement early descriptions which are inconsistent in some particulars.

The yellowish white body is up to 24.2×0.7 mm in the male and 34.3×1.0 mm in the female. The cuticle has very fine transverse striations, which are most pronounced directly behind the small head up to 0.21 mm broad. The three lips, up to 0.1 mm long, have each two ear-shaped anterior projections and a longitudinal furrow on the inner surface; the dorsal lip has two double papillae, and the subventral one each. The incurved interlabia are only slightly shorter than the lips. The cervical papillae lie at about the same level as the nerve ring, 0.4–0.6 mm from the head end. The esophagus, the elongate fusiform ventricular appendix and the intestinal cecum are 1.5–3.5 mm, 0.55–0.87 mm and 1.0–2.6 mm long respectively.

MALE. The ventrally curved conical tail is 0.18–0.2 mm long. There are

21 pairs of preanal papillae, of which the anteriormost lies 4.38 mm from the tail end in a specimen 20 mm long; in immature specimens, however, they are up to 26 in number. Of the 7 pairs of postanal papillae, four are subventral and the other three lateral, the first two being very close together just behind the anus. The slender alate spicules are up to 3.2 mm long.

FEMALE. The straight conical tail is 0.23–0.47 mm long and has a pair of lateral papillae behind its middle. The vulva divides the body length in the ratio of 1 : 1.5–2.0. The ellipsoidal thick-shelled eggs are about 60 × 42 μ and the contained unsegmented ova of eggs ready for birth, 45 × 30 μ.

2. *Contracaecum torquatum* n. sp.

DESCRIPTION. On March 25, 1927, I found at Kuki a larva, four male and two female adults of this species in the stomach of *Larus canus major* Middendorff. The body is 20–29 × 0.4–0.85 mm in the male and 34–43 × 1.0–1.2 mm in the female. The cuticle shows exceedingly fine logitudinal elevations interrupted by cross-striations. The head is up to 0.24 mm broad. Each rounded lips, up to 120 μ long, has on either side of its anterior edge two globular swellings united at the base and covered by a very thick cuticle, and on the inner side two slightly chitinous divergent processes with a small pointed tip, which does not project beyond the anterior end of the outer swelling mentioned above. There are very small denticulations on the surface of the swellings and on the anterior edge of the processes. There are two double papillae on the dorsal lip, but one simple and one double papilla on each subventral. The incurved interlabia are 54–80 μ long and may be bifid at the anterior end. The laminate cuticle of the neck forms numerous close circular folds with anteriorly directed lappets, as shown in fig. 3. The nerve ring lies in front of the cervical papillae, 0.43–0.63 mm from the head end.

Fig. 4

Fig. 3

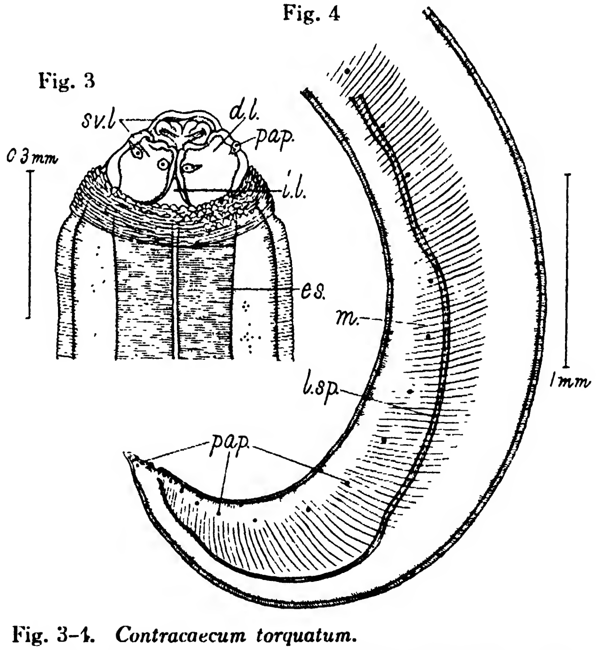

Fig. 3–4. *Contracaecum torquatum.*
Fig. 3. Anterior extremity of female, flattened; dorso-lateral view.
Fig. 4. Posterior extremity of male; lateral view.

The esophagus is 2.3–3.6 mm long by 0.26–0.3 mm broad. The approximately fusiform ventricular appendix is 0.5–0.8 mm long and the intestinal cecum 1.9–2.7 mm long. The conical tail is 0.17–0.18 mm long in the male and 0.35 mm long in the female, in which it has a pair of lateral papillae near its end. The slender spicules are 3.9–4.6 mm long. There are 29–36 pairs of preanal and 7 pairs of postanal papillae. The two papillae lying immediately behind the cloacal aperture are large and sessile; of the other five postanal papillae three are lateral and two subventral.

The vulva divides the body length in the ratio of 1 : 2.27–2.35. The oval to globular, thick-shelled eggs in the 2-cell stage are 63–74 × 51–63 μ.

In the larva 9.0 mm long the three lips of the head are well defined, but the neck appears as a mere constriction. The esophagus, the ventricular appendix and the intestinal cecum are 1.15 mm, 0.5 mm and 0.85 mm long respectively, so that the ventricular appendix is relatively longer in the larval stage, a fact to be taken into consideration in the identification of *Contracaecum* larvae.

DISCUSSION. This species differs from the closely related *Contracaecum spiculigerum* (Rud., 1809) in the number of preanal papillae, and probably also in the structure of the lips and neck.

Contracaecum torquatum n. sp.

SPECIFIC DIAGNOSIS. *Contracaecum* Railliet et Henry, 1912. Male 20–29 × 0.4–0.85 mm, female 34–43 × 1.0–1.2 mm. Head up to 0.24 mm broad. Each lip with two divergent processes on inner side. Interlabia slightly incurved, shorter than lips. Cuticle of neck forming numerous close circular folds with anteriorly directed lappets. Tail conical, 0.17–0.18 mm long in male, 0.35 mm long and with a pair of lateral papillae in female. Esophagus 2.3–3.6 mm long. Ventricular appendix 0.5–0.8 mm long. Intestinal cecum 1.9–2.7 mm long. Spicules 3.9–4.6 mm long. Preanal papillae in 29–36 pairs, postanals in 7 pairs. Vulva dividing body length in ratio of 1:2.27–2.35. Eggs oval to globular, 2-segmented, 63–74 × 51–63 μ.

Habitat. Stomach of *Larus canus major* Middendorff.

Locality and date. Mië Prefecture; March 25, 1927.

Type and paratypes in my collection.

3. *Contracaecum milvi* n. sp.

DESCRIPTION. Two males (28.12–28.75 × 1.0 mm) and one immature female (31.28 × 1.18 mm) were collected by Mr. Ô of Tainan Normal School from the esophagus and stomach of *Milvus migrans formosanus* Kuroda.

The head, about 0.2 mm broad, is sharply marked off from the broader, finely folded ensuing part. The lips, 0.11–0.13 mm long, are divided anteriorly into two rounded projections, each of which has a small cuticular boss on the outer side. The dorsal lip has two double papillae but the subventral lip a single double one. The interlabia, only slightly shorter than the lips, are strongly incurved at the rounded, not constantly bifid tip. The nerve ring lies 0.6 mm from the head end in the male. The acutely conical tail is 0.24–0.25 mm long in the male and 0.33 mm in the female. The esophagus, the ventricular appendix and the intestinal cecum are 4.38–4.5 mm, 0.65 mm and 3.1–3.75 mm

long respectively.

There are on either side 22 preanal and 6 postanal papillae, the first two of the latter being double. The two slender alate spicules are 7.5–8.7 mm long.

The small inconspicuous vulva lies 11.9 mm from the head end.

DISCUSSION. This species differs from the closely related *Contracaecum haliaëti* Baylis et Daubney, 1923, in the characters of the lip papillae and of the interlabia. The male of *C. haliaëti* is unknown, while none of my specimens contained eggs, so that no direct comparison of the two species can be made. The specific diagnosis is reserved until gravid females are obtained.

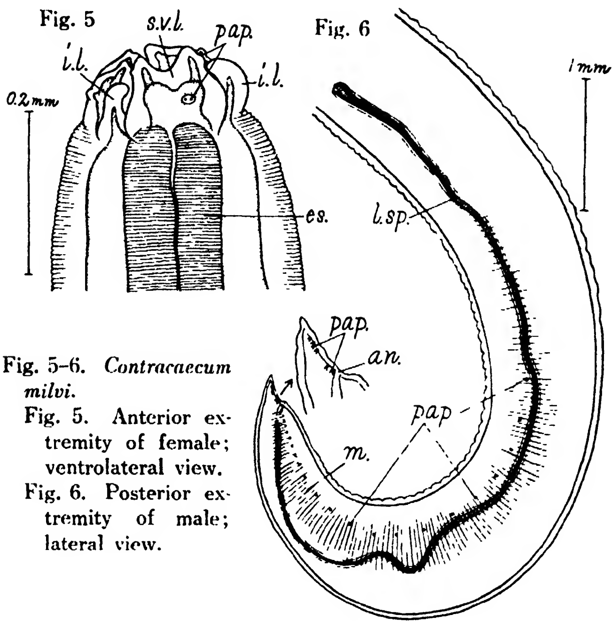

Fig. 5–6. *Contracaecum milvi.*
Fig. 5. Anterior extremity of female; ventrolateral view.
Fig. 6. Posterior extremity of male; lateral view.

1. *Porrocaecum reticulatum* (von Linstow, 1899) Baylis et Daubney, 1922

Several mature and immature specimens of this species were found in the small intestine of *Nycticorax nycticorax nycticorax* from various localities.

The finely cross-striated body is up to 54 × 1.25 mm in the male and 73 × 1.5 mm in the female. The lips, up to 0.28 mm long, are finely denticulated at the margin and the pulp is produced forwards into two convergent projections. The inner surface of each lip has an anteriorly directed digitiform process not projecting beyond the lip margin. The short interlabia are 0.15 mm in maximum length. The nerve ring lies 0.8–0.9 mm from the head end. The cervical papillae are level with the nerve ring or just behind it. The lengths of the esophagus and intestinal cecum are 3.75 mm and 2.85 mm respectively in the largest male, while in the largest female they are 6.0 mm and 4.5 mm respectively. The pointed tail of the male, up to 0.44 mm long, is constricted in front of its middle, and bears three

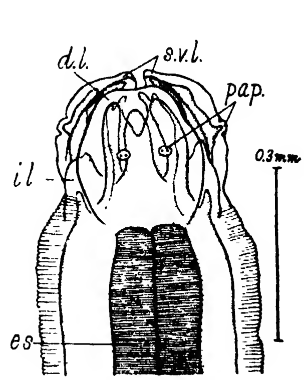

Fig. 7. Anterior extremity of male *Porrocaecum reticulatum* (v. Linst., 1899); dorsal view.

subventral and one small lateral papillae, the latter near the last subventral; the first subventral is very large and lies just behind the cloacal aperture. There are 5 pairs of preanal papillae, the first one lying about 1.0 mm in front of the anus. The gubernaculum appears to be present, but the spicules could not be clearly observed.

The conical tail of the largest female is 1.0 mm long, and bears a pair of lateral papillae at 0.338 mm from the tip. The vulva lies in this specimen about 22 mm from the head end. The oval eggs in the first cleavage stage are about 110 μ long by 96 μ broad; the shell, 6 μ thick, has a reticulate appearance. The description given above agrees largely with that of Hsü which is based on the material from Chungking, West China.

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Hsü, H. F. Some species of *Porrocaecum* (Nematoda) from birds in China. Jour. Parasit., Vol. 19, No. 4, 1933, p. 284–285.

5. *Porrocaecum angusticolle* (Molin, 1860) Baylis et Daubney, 1920

Two gravid females of this species were found on January 23, 1933, in the small intestine of *Milvus lineatus lineatus* (Gray) from Siga Prefecture.

The body, 88.75–108.38 × 1.5–1.8 mm, is finely cross-striated. The head

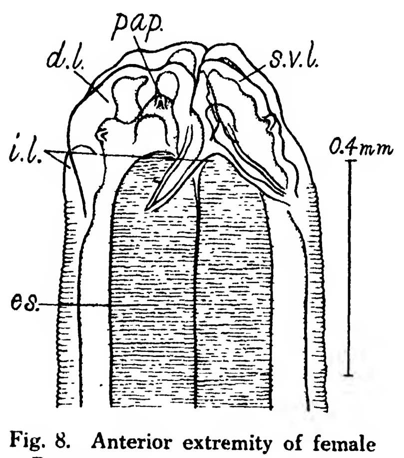

Fig. 8. Anterior extremity of female *Porrocaecum angusticolle* (Molin, 1860); lateral view.

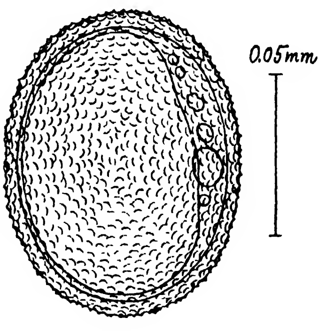

Fig. 9. Egg of *Porrocaecum angusticolle* (Molin, 1860).

is 0.38–0.42 mm broad. The cuticular band arising from each side of the base of the lip passes forwards on the inner side of the lateral expansion of the cuticle and is continued into the anterior margin of the lip. The lips are 0.27–0.3 mm long and the interlabia 0.12–0.15 mm long. The blunt tail is up to 0.9 mm in length. The vulva lies in the anterior part of the middle third of the body. The oval, thick-shelled eggs with reticulate surface are 80–96 μ

long by 66–84 μ broad; they contain strongly refractive droplets between the shell and the ovum.

HETERAKIDAE Railliet et Henry, 1914

6. *Heterakis gallinae* (Gmelin, 1790) Freeborn, 1923

This species was found in the ceca of *Gallus domesticus*, *Phasianus versicolor versicolor* and *Graphophasianus sömmerringii scintillans* from various localities of Japan.

The following note is based on the best developed specimens from the two last mentioned hosts. Body up to 10.7 mm in male, 12.55 mm in female; esophagus exclusive of its anterior part (pharynx) 0.98–1.18 mm long and 0.2–0.25 mm broad at basal bulb; nerve ring 0.35–0.45 mm from head end; tail 0.45–0.5 mm long in male and 0.85–1.3 mm long in female; sucker up to 114 μ in diameter; longer spicule simple, up to 2.2 mm long, shorter one alate except at distal tip, up to 1.0 mm long; anal papillae in 12 pairs: two slender ones beside sucker, four long outer and two short inner ones beside anus, the others postanal (10th smallest, 11–12th coupled); vagina reflexed; vulva usually a little behind middle of body but may be in front of it; eggs ellipsoidal, thick-shelled, 63–72 × 43–50 μ; ova not segmented.

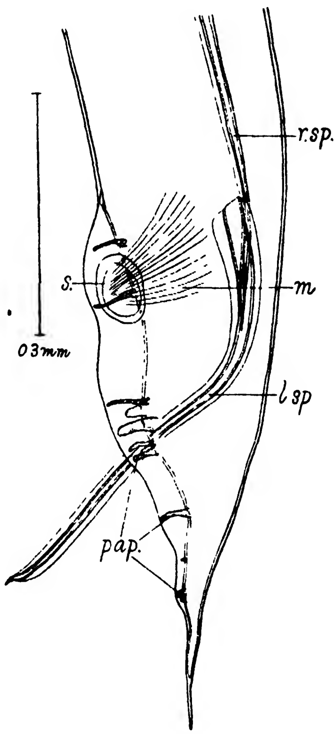

Fig. 10. Posterior extremity of male *Heterakis gallinae* (Gmelin, 1790); lateral view.

7. *Ascaridia galli* (Schrank, 1788) Freeborn, 1923

Some points in which I disagree with earlier workers will be mentioned.

The sucker of the male is slightly attenuated at the posterior median rim but neither interrupted nor followed by a sessile median papilla. In a specimen 51 mm long, the subequal spicules are 2.05 mm and 1.93 mm long respectively.

There are 10 pairs of anal papillae, the first anterolateral and the second exactly lateral to the sucker; the third to seventh zigzag in the vicinity of the anus; the eighth, very small and overlooked by earlier workers, to tenth forming an isolated group near the tail tip.

The vulva lies at about the middle of the body. The elliptical, thick-shelled eggs are 72–78 μ long by 45–51 μ broad; the contained ova are not segmented.

Fig. 12

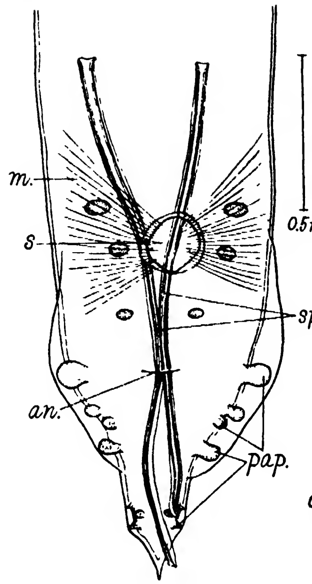

Fig. 11

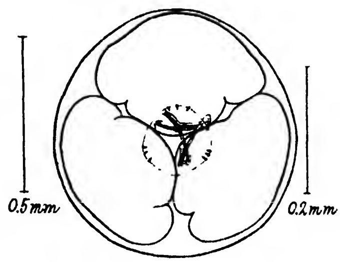

Fig. 13

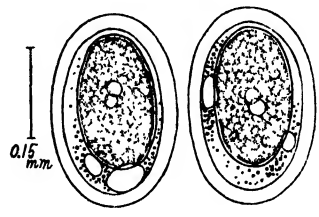

Fig. 11–13. *Ascaridia galli* (Schrank, 1788).
Fig. 11. Head of female; end-on view.
Fig. 12. Posterior extremity of male; ventral view.
Fig. 13. Eggs.

This species is common in Japanese chickens. The largest female in my hands is 75 mm long.

8. *Ascaridia columbae* (Gmelin, 1790) Travassos, 1913

One male, 20.68 × 0.63 mm, and two females, 40.88–45 × 0.98–1.2 mm, from the small intestine of *Columba domestica*, the former from Kyoto and the latter collected by Mr. Ukyô Ô at Tainan, Formosa.

The finely cross-striated body shows a marked dorsal flexure at the anterior extremity. There is on either side a narrow cervical membrane. The conical tail with a terminal spike is 0.42 mm long in the male and 0.9 mm long in the female. The head is 0.14–0.28 mm broad. The three lips are 0.07–0.11 mm long and bear each two papillae, those of the dorsal lip being smaller and inconspicuous. The posteriorly broadened muscular esophagus is 1.25 mm long in the male and 2.2–2.3 mm long in the female.

The sucker with chitinous walls measures about 0.2 mm anteroposteriorly. There are 11 pairs of rounded anal papillae, two preacetabular small and elongate, and the sixth just medial to the seventh. The two spicules are 1.47 mm long.

The vulva lies just behind the middle of the body. The ellipsoidal, thick-shelled eggs are 70–75 μ long by 47–52 μ broad.

SUBULURIDAE Yorke et Maplestone, 1926

9. *Subulura taiwanensis* n. sp.

Two male and four female adults were obtained by Mr. Ukyô Ô at Tainan from the small intestine of *Excalfactoria chinensis* (Linné). The body, 9.8–11.35 × 0.42–0.51 mm in the male and 15.4–20.8 × 0.58–0.78 mm in the female, is covered by a relatively thick, finely cross-striated cuticle, and more or less strongly recurved dorsad at the anterior extremity. The lateral alae up to 0.14 mm broad extend to the anterior part of the intestine. The ex-

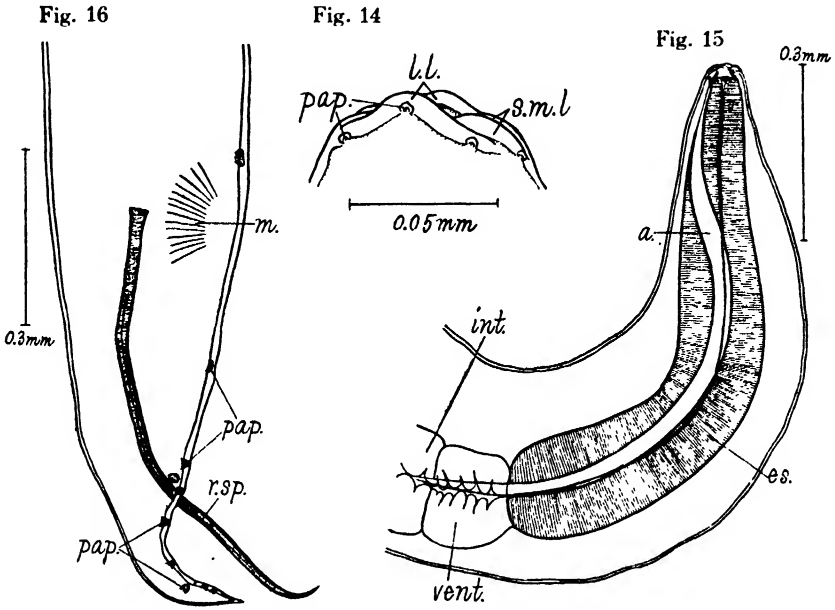

Fig. 14–16. *Subulura taiwanensis.*
Fig. 14. Head of male; lateral view.
Fig. 15. Anterior extremity of male; lateral view.
Fig. 16. Posterior extremity of male; lateral view.

cretory pore lies 0.49 mm from the head end in the female. The mouth is bounded by two large, 3-papillated lateral lips and four smaller submedian lips with one papilla each and a very conspicuous notch between. The esophagus is 0.98 × 0.16 mm in the male and 1.19–1.26 × 0.18–0.21 mm in the female. The spherical esophageal bulb is 0.15–0.21 mm in diameter. The conical tail of the female is up to 0.5 mm long, while that of the male is 0.22–0.26 mm long and curved ventrad.

The caudal alae are feebly developed. There are 5 pairs of preanal and 6 pairs of postanal papillae; the anteriormost pair lies 0.5–0.6 mm from the anus, just in front of the preanal sucker; the fourth and eighth are lateral, and the ninth is definitely smaller than the others. The two spicules are 0.77–0.86 mm long. The gubernaculum could not be clearly made out. The preanal

sucker is poorly defined and has no chitinous rim.

The gravid uterus may extend farther backward than the anus. The not salient vulva lies a little in front of the middle of the body. The subglobular, not very thin-shelled, embryonated eggs are 47–61 μ long by 39–48 μ broad.

DISCUSSION. This species differs from the related *Subulura olympioi* Barreto, 1918*), chiefly in the sizes of the body and eggs.

Subulura taiwanensis n. sp.

SPECIFIC DIAGNOSIS. *Subulura* Molin, 1890. Male 9.8–11.35 × 0.42–0.51 mm. Female 15.4–20.8 × 0.58–0.78 mm. Lateral alae extending to beginning of intestine. Lateral lips 3-papillated, submedian 1-papillated. Tail 0.22–0.26 mm long in male, up to 0.5 mm long in female. Esophagus 0.98 × 0.16 mm in male, 1.19–1.26 × 0.18–0.21 mm in female. With 5 preanal and 6 postanal pairs of papillae. Spicules 0.77–0.86 mm long. Vulva a little pre-equatorial. Eggs subglobular, embryonated, 47–61 × 39–48 μ.

Habitat. Small intestine of *Excalfactoria chinensis* (Linné).

Locality and date. Formosa; April 4, 1934.

Type and paratypes in my collection.

FILARIIDAE Claus, 1885

10. *Diplotriaena bargusinica* Skrjabin, 1917

Four mature males and six gravid females were found in the body cavity

Fig. 18

Fig. 17

Fig. 19

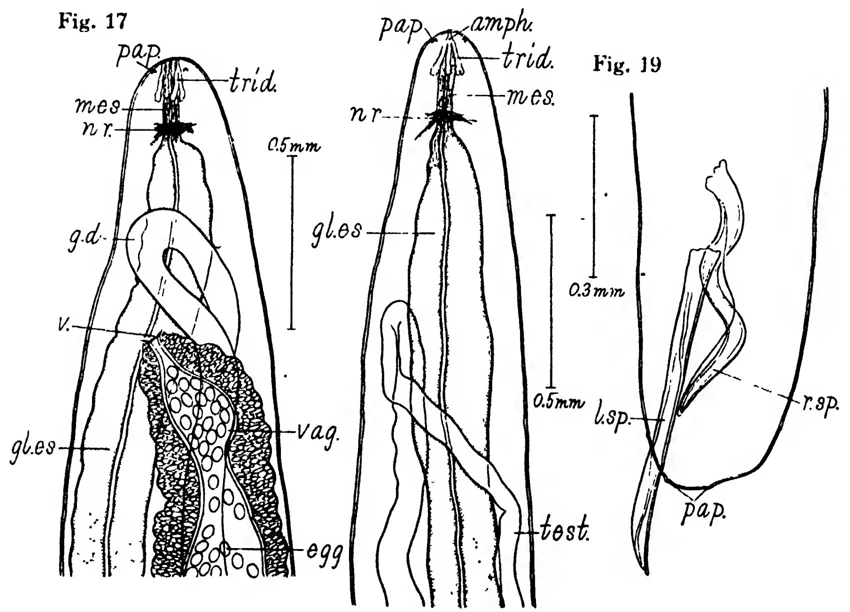

Fig. 17–19. *Diplotriaena bargusinica* Skrjabin, 1917.
Fig. 17. Anterior extremity of female; ventral view.
Fig. 18. Same of male; lateral view.
Fig. 19. Posterior extremity of male; lateral view.

*) Cited from Cram, l. c., p. 121.

of *Turdus* (*Turdus*) *eunomus* Temminck from Tottori Prefecture.

The body with a thin smooth cuticle is up to 40 × 0.6 mm in the male and 104 × 0.8 mm in the female. At the head end there are four large submedian papillae and two lateral amphids. The trident is up to 132 μ long; each tooth has at its swollen posterior end numerous minute tubercles, the middle tooth being slightly shorter than the others. The anterior muscular part of the esophagus is a little longer (up to about 0.3 mm) in the male than in the female and is surrounded at the posterior end by the nerve ring, which lies 0.18–0.3 mm from the head end; the broader posterior glandular part, 3.4–4.1 mm long, is sharply constricted off from the intestine.

The almost straight spicule is 0.53–0.6 mm long and the spiral one 0.44–0.54 mm long. There are about three pairs of flat inconspicuous anal papillae.

The vulva lies 0.75–0.8 mm from the head end. The oval, thick-shelled, embryonated eggs as fixed in alcohol and measured in water are 54–60 μ long by 39–42 μ broad.

Although the above description differs from that of Skrjabin, particularly as regards the position of the vulva and the length of eggs, I prefer to assign my worm to his species from Siberia.

11. *Diplotriaena manipoli* Chu, 1931

Four males, 34–38 × 0.5–0.6 mm, and six females, 88–126 × 0.8–1.0 mm, were found in the body cavity of *Garrulus glandarius japonicus* Schleg. from Sizuoka Prefecture.

The body is greyish white to dark brown. The cuticle is thin and almost entirely smooth except at the extremities which show indistinct transverse striations. The head bears on either side two large submedian papillae and one lateral amphid. The trident, 84–105 μ long, has no tubercles or corrugations. The spiral spicule is 0.75–0.88 mm long and the other slightly arcuate one 1.12–1.28 mm long. There are several inconspicuous papillae on either side of the male genital aperture. The vulva lies 0.45–0.56 mm from the head end. The oval, thick-shelled, embryonated eggs as fixed in alcohol and measured in water are 51–58 μ long by 36–40 μ broad.

12. *Diplotriaena monticolae* n. sp.

DESCRIPTION. Three male and as many female adults were collected by Mr. Ukyô Ô from the body cavity of *Monticola solitarius magnus* (La Touche).

The body, 30–35 × 0.55–0.7 mm in the male and 44–52 × 0.9–1.0 mm in the female, is brownish grey and has a thin, finely cross-striated cuticle. Each lateral trident, up to 0.24 mm long, bears a chitinous cap at its anterior projecting tip; the three teeth are not corrugated, but possess several tubercles; the middle tooth is slightly shorter than the others, which are in direct contact with the corresponding teeth of the opposite side at the posterior ends. Around the head there are four submedian papillae and two lateral amphids, as in

other members of the genus. The nerve ring lies just behind the tridents, about 0.25 mm from the head end.

The straight, distally alate spicule is 0.6–0.72 mm long, and the spiral one 0.81–0.85 mm long and alate almost along its entire length. In the vicinity of the subterminal male aperture there are 8 pairs of large flat papillae.

Fig. 20

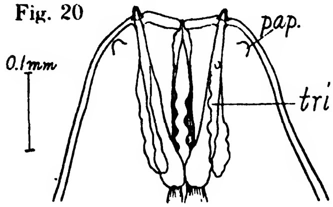

Fig. 21

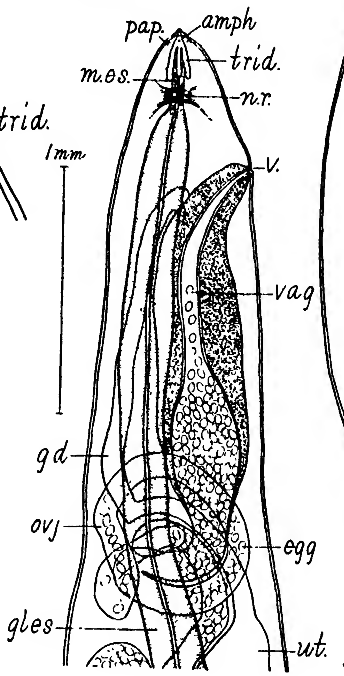

Fig. 22

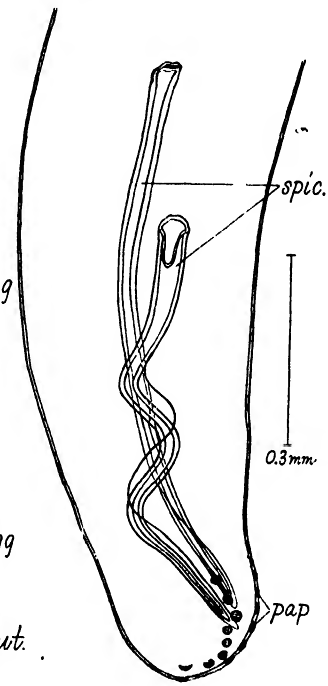

Fig. 20-22. *Diplotriaena monticolae*.
Fig. 20. Head of male; dorsal view.
Fig. 21. Anterior extremity of female; lateral view.
Fig. 22. Posterior extremity of male; lateral view.

The long ovijector is strongly convoluted before leading into the muscular vagina. The vulva lies 0.32–0.56 mm from the anterior extremity. The oval, thick-shelled, embryonated eggs are 51–59 × 36–42 μ. The tail of the female bears at its end small papillae, whose number could not be ascertained.

DISCUSSION. This species differs from the most closely related *Diplotriaena corrugata* Wehr, 1930, and *D. pungens* (Schneider, 1866) of Boulenger in body size, in the structure of the tridents, etc.

Diplotriaena monticolae n. sp.

SPECIFIC DIAGNOSIS. *Diplotriaena* Railliet et Henry, 1909. Body brownish grey to dark brown, 30–35 × 0.55–0.7 mm in male, 44–52 × 0.9–1.0 mm in female. Cuticle very finely cross-striated. Tridents up to 0.24 mm long, with chitinous cap at anterior tip; teeth tuberclated, but not corrugated. Straight spicule 0.6–0.72 mm long, spiral one 0.81–0.85 mm long. 8 pairs of genital papillae in male. Vulva 0.32–0.56 mm from head end. Eggs oval, 51–59 × 36–42 μ.

Habitat. Body cavity of *Monticola solitarius magnus* (La Touche).

Locality and date. Formosa; October 7, 1932.

Type and paratypes in my collection.

LITERATURE CITED

Boulenger, C. L. Report on a collection of parasitic nematodes, mainly from Egypt. Parasit., Vol. 20, 1928, p. 46–48.

Chu, H. J. Nematodes from flying lemurs in the Philippine Islands and from birds in China. Jour. Parasit., Vol. 17, 1931, p. 158–159.

Skrjabin, K. I., Sur quelques nématodes des oiseaux de la Russie. Parasit., Vol 9, 1917, p. 471–473.

Wehr, E. E. New species of bird nematodes from the Philippine Islands. Jour. Parasit., Vol. 17, No. 2, 1930. p. 83–84.

13. *Eufilaria lari* n. sp.

DESCRIPTION. Four gravid females were found in the outer wall of the esophagus of *Larus canus major* Middendorff from Mie Prefecture. The cylindrical body, 9.8–11.7 × 0.37–0.5 mm, is slightly attenuated toward the anterior end and rounded at the extremities. The cuticle has very fine transverse striations. The lateral fields are about 0.2 mm broad. On either side of the mouth is a very inconspicuous papilla. The thickened cuticle at the mouth opening may form a dorsal and a ventral indefinite lip. The slender glandular esophagus is 0.3–0.33 mm long and 33–38 μ broad at the slightly enlarged base, and has a small appendix projecting into the intestine, which is atrophied posteriorly into a column of cells attached to the caudal extremity a little to its ventral side.

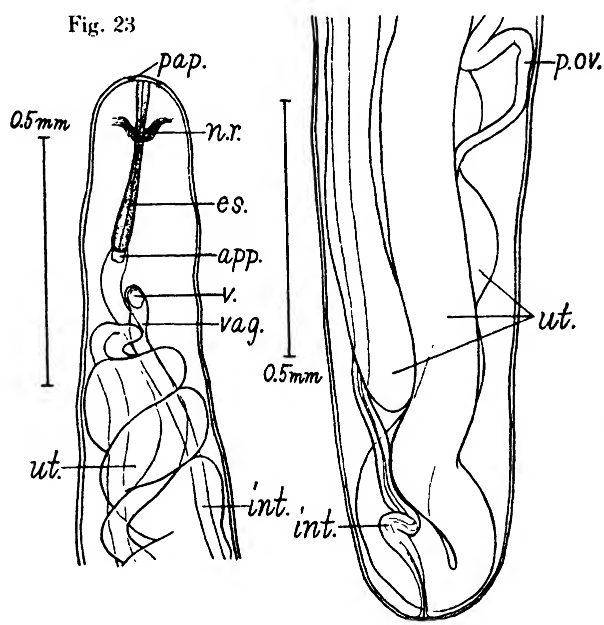

Fig. 23–24. *Eufilaria lari*.
Fig. 23. Anterior extremity of female; ventral view.
Fig. 24. Posterior extremity of female; lateral view.

The vulva lies 0.4–0.65 mm from the head end, nearly level with the posterior end of the esophagus in the type. The uterus may extend anteriorly to the nerve ring, which lies 0.1–0.12 mm from the head end, and posteriorly to the extreme end of the body or stop immediately in front of the anal nerve ring. The oval eggs are thin-shelled. The free embryos in the uterus are up to 84 μ long, some enclosed in a sheath projecting beyond the extremities of the embryonic body, and others naked, probably due to

difference in development.

DISCUSSION. Although this species does not fit well into *Eufilaria* Seurat, 1921, yet I venture to refer it to this genus. As pointed out by Baylis and Daubney *Eufilaria* may be congeneric with *Aprocta* v. Linst., 1883, because the differences stated to exist in the eggs and embryos are probably due to errors of observation. The peculiar structure of the esophagus as described by Seurat requires further study.

Eufilaria lari n. sp.

SPECIFIC DIAGNOSIS. *Eufilaria** Seurat, 1921. Gravid females 9.8-11.7 × 0.37-0.5 mm. Cuticle with very fine transverse striations. Two very inconspicuous papillae on either side of mouth. Esophagus glandular, slender, 0.3-0.33 mm long. Intestine without lumen at posterior end. Vulva 0.4-0.65 mm from head end Embryos up to 84 μ long; some sheathed, others naked.

Habitat. Esophageal serosa of *Larus canus major* Middendorff.

Locality and date. Pacific coast of Mie Prefecture; March 23, 1927.

Type and paratypes in my collection.

LITERATURE CITED

Baylis, H. A. and Daubney, R. A synopsis of the families and genera of Nematoda, p. 205 206. London, 1926.

14. *Spirofilaria podicipitis* n. g. n. sp.

DESCRIPTION. One male and four females from the inguinal connective tissue of *Podiceps ruficollis japonicus* Hartert from Lake Biwa. The body, attenuated at both ends, is twisted regularly 3 or 4 times in a spiral and bears conspicuous lateral cuticular expansions along the entire length. The cuticle is finely striated transversely. The nerve-ring lies 0.12-0.15 mm from the head end. The lipless mouth is surrounded by four small submedian papillae, and leads directly into the esophagus, which is divided into an anterior feebly muscular (100-294 × 30-36 μ) and a posterior somewhat glandular part (318-325 × 40-48 μ). The slender intestine terminates in a fusiform swelling attached to the posterior end of the body.

MALE. The male is 9.4 mm long and 0.45 mm broad including the lateral alae, each up to 45 μ thick. The anterior end of the tubular testis is 2.7 mm from the head. There are several (7 ?) pairs of caudal papillae, the anteriormost one lying about 0.4 mm from the blunt tail end, where the rest are close together one behind the other. The spicules could not be observed, probably because they appear in a relatively later stage of development.

FEMALE. In two of the four specimens measuring 18.75-22 mm long and up to 0.8 mm broad, the internal organs are much atrophied or degenerated, while the smallest example selected for type has just attained maturity and the remaining one is fully gravid. At the posterior end of the body there are

*The original diagnosis is subject to later emendation.

two pairs of very inconspicuous papillae. In the type the two slender ovaries begin near the posterior end of the body, with their slightly enlarged ends directed backward, and form each a fusiform swelling 0.09 mm broad before leading into the germiducts, which form several loops between the ovaries and the uteri. The two somewhat twisted uteri unite 2.5 mm from the head end into a voluminous sac, which tapers rapidly to form a long cylindrical muscular vagina. The prominent vulva is level with the beginning of the intestine. The fully developed embryos, up to 0.1 mm long, are without sheath.

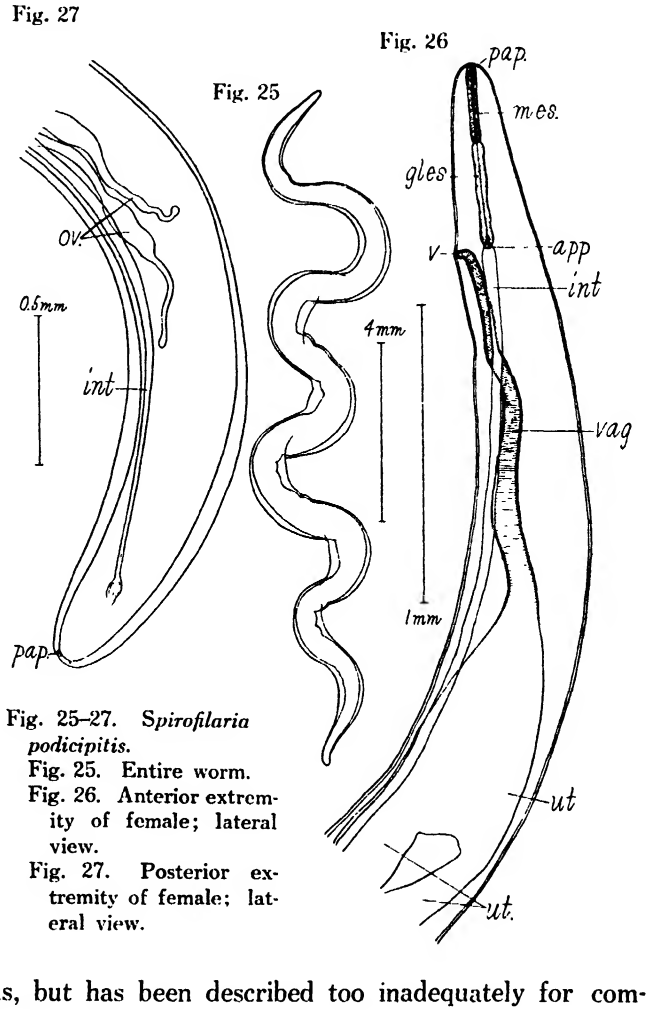

Fig. 25–27. *Spirofilaria podicipitis*.
Fig. 25. Entire worm.
Fig. 26. Anterior extremity of female; lateral view.
Fig. 27. Posterior extremity of female; lateral view.

DISCUSSION. This genus, apparently belonging to Filariidae, bears a closer resemblance to the reptilian parasite *Saurositus* Macfie, 1924, than to any of the known genera from birds, but differs from it in body shape, in the presence of lateral cuticular expansions along the whole body, in the arrangement of the anal papillae, etc.

Spiroptera helix von Linstow, 1899, probably belongs to this genus, but has been described too inadequately for comparison.

Spirofilaria n. g.

GENERIC DIAGNOSIS. Filariidae Claus, 1885. Body spiral, with lateral cuticular expansions along its whole length. Cuticle finely cross-striated. Mouth simple, without lips, with four small submedian papillae. Esophagus divided into two portions, a short narrow anterior and a slightly longer posterior. Intestine narrow. Anus atrophied. Male without caudal alae; caudal papillae close together, but a single pair lying farther in front than the rest. Female with a few minute papillae at its blunt posterior extremity; two ovaries beginning near posterior extremity; uteri

united in front; vulva level with posterior end of esophagus. Viviparous; fully developed embryos without sheath. Parasitic in birds.

Genotype. *Spirofilaria podicipitis.*

Spirofilaria podicipitis n. sp.

SPECIFIC DIAGNOSIS. *Spirofilaria;* with generic characters. Male (immature) 9.4×0.45 mm, female (gravid) up to 22×0.8 mm. Nerve ring 0.12–0.15 mm from head end. Anterior portion of esophagus up to 294×36 μ, posterior up to 325×48 μ. Male with 7 (?) pairs of caudal papillae, anteriormost one about 0.4 mm from tail end. Female with 2 pairs of terminal papillae. Embryos up to 0.1 mm long.

Habitat. Inguinal region of *Podiceps ruficollis japonicus* Hartert.

Locality and date. Lake Biwa; December 19, 1931.

Type and paratypes in my collection.

LITERATURE CITED

Macfie, I. W. S. *Saurositus agamae,* n. g. n. sp. A filarioid parasite of the lizard *Agama colonorum.* Ann. Trop. Med. & Parasit., Vol. 18, 1924, p. 409–412.

von Linstow, O. Parasitische Nematoden. Brauer's Süsswasserfauna Deutschlands, Heft 15, 1909, p. 64.

SPIRURIDAE Oerley, 1885

15. *Cyrnea graphophasiani* n. sp.

DESCRIPTION. Four male and thirteen female adults were found in the proventriculus of *Graphophasianus sömmerringii scintillans* from Hyôgo Prefecture and Kyûsyû. The males are 7.8–12.7 × 0.24–0.28 mm and the females 14–24.4 × 0.34–0.475 mm. In the female, the tail is elongate conical, 0.27–0.42 mm long and has a pair of lateral papillae near its end, but in the male it is only 0.13–0.15 mm long. The cuticle is thick and very finely striated transversely. The parietal musculature is well developed. The nerve ring lies 0.19–0.36 mm from the head end. The inconspicuous cervical papillae lie just behind the nerve ring. Each lateral lip of the mouth is rounded at the free edge and has a dorsal and a ventral cuticular lobe projecting into the wide median notch of the dorsal and ventral lips; on its inner surface are two prominent and one rather flat chitinous tooth-like ridges. The dorsal and ventral lips are divided each into two prominent submedian horns, each with a papilla on the outer side. The cylindrical buccal capsule, 30–63 μ deep, is lined by a thick cuticle. The anterior muscular part of the esophagus is 0.22–0.5 mm long by 27–57 μ broad, and the posterior glandular 1.92–3.5 mm long by 0.09–0.125 mm broad at the base, with a small appendix projecting into the intestine.

The caudal alae, 0.31–0.38 mm long and 0.25–0.28 mm from margin to margin, are supported by 9 pairs of costiform papillae, of which the 4 posterior are smaller. The third pair is almost level with the anus, directly in front of which is an additional pair of small sessile papillae. The left spicule is 1.1–1.35 mm long and the right one 0.42–0.52 mm long. The gubernaculum is about 70 μ in length.

The not very prominent vulva lies 1.1–1.67 mm from the caudal extremity. The pyriform vestibule of the vagina containing a mass of eggs is 0.17–0.25 mm long. The ellipsoidal, thick-shelled, embryonated eggs are 42–47 × 21–27 μ.

Fig. 28

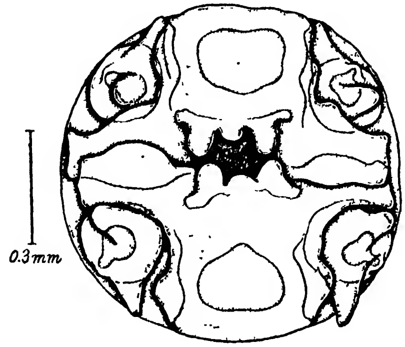

Fig. 29

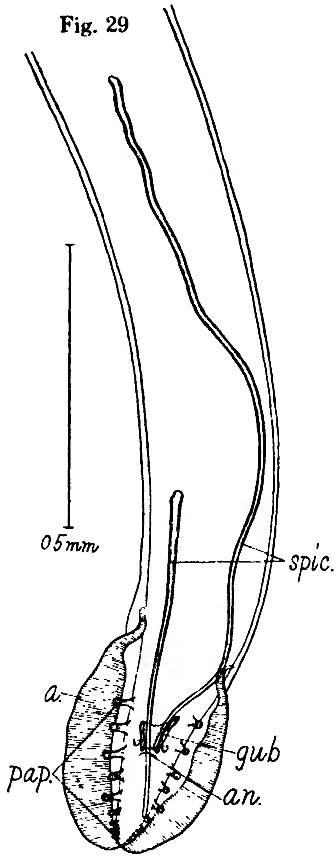

Fig. 28-29. *Cyrnea graphophasiani.*
Fig. 28. Head of female; end-on view.
Fig. 29. Posterior extremity of male; ventral view.

. DISCUSSION. This species differs from the closely related *C. parroti* Seurat, 1917, and *C. piayae* Sandground, 1929, in the tail length of the female, in the length of eggs, etc.

Cyrnea graphophasiani n. sp.

SPECIFIC DIAGNOSIS. *Cyrnea* Seurat, 1914; with generic characters. Cuticle thick, very finely striated transversely. Each lateral lip with three internal teeth and one external papilla, and projecting into median notches of dorsal and ventral lips. Buccal capsule 30–63 μ deep. Anterior muscular part of esophagus 0.22–0.5 × 0.027-0.057 mm, posterior glandular 1.92–3.5 × 0.09–0.125 mm. Male 7.8–12.7 × 0.24–0.28 mm; tail 0.13–0.15 mm. Caudal alae 0.31–0.38 mm long, 0.25–0.28 mm across, supported by 9 pairs of pedunculated papillae; an additional pair of small sessile papillae immediately in front of anus. Left spicule 1.1–1.35 mm long, right one 0.42–0.52 mm long. Gubernaculum about 70 μ long. Female 14–24.4 × 0.34–0.475 mm; tail 0.27–0.42 mm long. Vulva not very salient, 1.1–1.67 mm from tail end. Pyriform vestibule of vagina 0.17-0.25 mm long. Eggs 42–47 × 21–27 μ.

Habitat. Proventriculus of *Graphophasianus sömmerringii scintillans.*
Locality. Hyôgo Prefecture (type locality); Kyûsyû.
Date. February 20, 1927.
Type and paratypes in my collection.

16. *Cyrnea excisiformis* n. sp.

DESCRIPTION. Three males, 8.0–8.4 × 0.37–0.39 mm, and two females, 11.6–11.95 × 0.57–0.6 mm, from the stomach of *Asio otus otus* (Linné). The

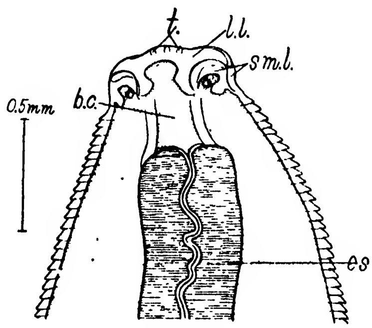

Fig. 30. Anterior extremity of male *Cyrnea excisiformis*; lateral view.

Fig. 31

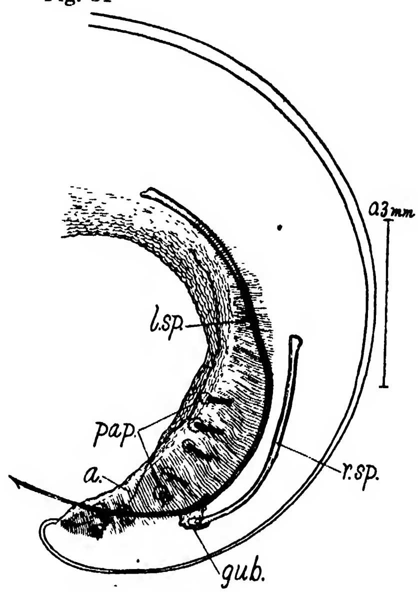

Fig. 32

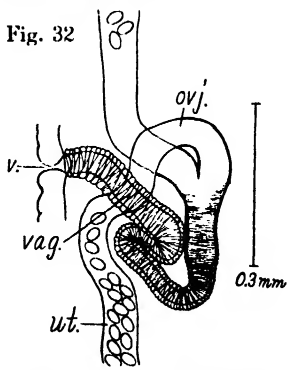

Fig. 31–32. *Cyrnea excisiformis*.
Fig. 31. Posterior extremity of male; lateral view.
Fig. 37. Vulvar region; lateral view.

thick, finely cross-striated cuticle shows conspicuous imbrications at the anterior part. In the male the cuticle forms on the ventral side of the posterior end numerous close longitudinal rows of fine transversely incised elevations extending across the inner sides of the caudal alae to their free margins. The nerve ring lies 0.22–0.27 mm from the head end. The short head is 56–70 μ broad. Each lateral lip, with three chitinous teeth on the inner side, has a dorsal and a ventral process projecting into the groove between the submedian lips, which bear each a papilla on the outer side. The buccal cavity has a thick cuticular lining and is 22–28 μ long. The anterior muscular part of the esophagus is 0.33–0.38 mm long by 34–53 μ broad and the posterior glandular one 2.38–2.83 mm long by 0.18–0.24 mm broad. The blunt tail is 0.21–

0.28 mm long in the male and 0.22–0.25 mm in the female.

The well developed caudal alae have numerous undulating transverse striations. There are four pairs of costiform preanal papillae and as many shorter, rather fungiform postanals, besides a large sessile unpaired papilla on the anterior margin of the cloacal aperture. The left longer spicule with a dorsal barb near its pointed tip is 1.05–1.12 mm long and the right one 0.39–0.42 mm long. A gorgeret is present.

The two ovijectors unite at about the level of the vulva into an approximately S-shaped muscular vagina. There is no vestibule for the storage of eggs. The inconspicuous vulva lies at about the middle of the body. The elongate oval, thick-shelled, embryonated eggs are 40–46 μ long by 25–28 μ broad.

DISCUSSION. This species resembles *Cyrnea excisa* (Molin 1860) Seurat, 1914, in the position of the vulva, but differs from it in body size, the number of caudal papillae, the length of spicules, the breadth of eggs, etc.

Cyrnea excisiformis n. sp.

SPECIFIC DIAGNOSIS. *Cyrnea* Seurat, 1914. Male 8.0–8.4×0.37–0.39 mm. Female 11.6–11.95 ×0.57–0.6 mm. Nerve ring 0.22–0.27 mm from head end. Each lateral lip with 3 teeth on inner side, projecting dorsally and ventrally into groove between submedian lips, which have each a papilla on the outer side. Buccal cavity 22–28 μ long. Anterior muscular esophagus 0.33–0.38× 0.034–0.053, posterior glandular 2.38–2.83×0.18–0.24 mm. Tail blunt, 0.21–0.28 mm long in male, 0.22–0.25 mm long in female. 8 pairs of anal papillae besides an unpaired one on anterior margin of cloacal aperture; 4 preanals costiform, 4 postanals shorter and rather fungiform. Left spicule 1.05–1.12 mm long, right one 0.39–0.42 mm long. Gorgeret present. Vagina sigmoid, without vestibule for storage of eggs. Vulva not prominent, at about middle of body. Eggs elongate oval, 40–46×25–28 μ.

Habitat. Stomach of *Asio otus otus* (Linné).
Locality. Unknown.
Date. January 24, 1934.
Type and paratypes in my collection.

LITERATURE CITED

Gram, E. B. Bird parasites of the nematode suborders Strongylata, Ascaridata and Spirurata. U. S. Nat. Mus. Bull., 140, 1927, p. 167 and 171.

Sandground, J. H. Some new parasitic nematodes from Yucatan (Mexico), including a new genus of strongyle from cattle. Bull Mus. Comp. Zool., Vol. 69, No. 14, 1929, p. 520–521.

ACUARIIDAE Seurat, 1913

17. *Dispharynx emberizae* n. sp.

DESCRIPTION. Four male and six female adults were found in the esophagus and proventriculus of *Emberiza spodocephala personata* (Temm.) from Sizuoka Prefecture. In the male, the slender body, 6–8 × 0.21–0.26 mm, makes two or three spiral turns posteriorly, but in the female, the body is swollen for the greater middle part, curved ventrad and 6.4–7.7 × 0.56–0.7 mm. The thick cuticle

is very finely striated transversely. The preanal region of the male is covered with longitudinal rows of transversely incised cuticular elevations. The two lateral triangular lips are very prominent and bear each two small papillae at the base. The sinuous finely cross-striated cordons are 0.39–0.63 mm long lineally and their recurrent, not anastomosing portions about half as long. The cervical papillae between the recurrent cordons are simple in the male but bi- or tricuspid in the female. The nerve ring lies at the anterior part of the muscular esophagus, about 0.23 mm from the head end. The cylindrical pharynx surrounded by fine circular muscle fibers is 92–140 μ long. The anterior mus-

Fig. 33

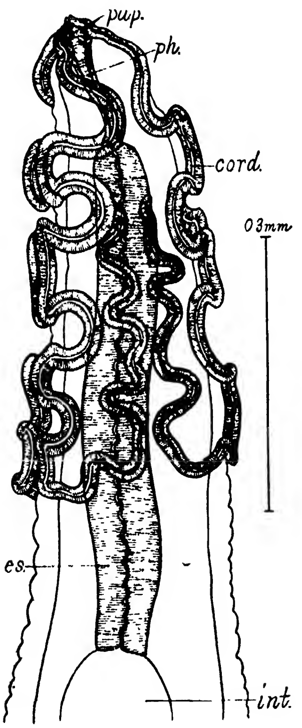

Fig. 34

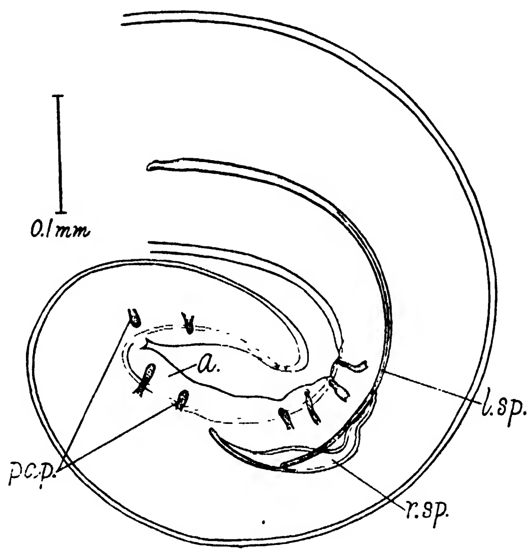

Fig. 33–34. *Dispharynx emberizae*.
Fig. 33. Anterior extremity of female; lateral view.
Fig. 34. Posterior extremity of male; lateral view.

cular esophagus is 0.46–0.66 × 0.061–0.067 mm and the posterior glandular 1.54–2.17 × 0.098–0.19 mm. The conical tail is 0.28–0.39 mm long in the male but only 0.14 mm or less in the female.

The simple caudal alae of the male arise very far in front of the cloaca. There are 4 preanal and 4 postanal pairs of pedunculate papillae, besides two small papillae just in front of the tail end. The left slender spicule is 0.39–0.49 mm long and the right navicular one 0.15–0.16 mm long.

The vulva divides the body length in the ratio of 3.0–4.4 : 1. The ellipsoidal, thick-shelled, embryonated eggs are 39–42 × 22–25 μ.

Discussion. This species bears a certain resemblance to ***Dispharynx***

rectovaginata (Molin, 1860) Cram, 1927*, but differs from it in having no marginal thickening of the caudal alae.

Dispharynx emberizae n. sp.

SPECIFIC DIAGNOSIS. *Dispharynx* Railliet, Henry et Sissoff, 1912. Male 6–8 × 0.21–0.26 mm, with 2–3 spiral coils posteriorly. Female 6.4–7.7 × 0.56–0.7 mm. Descending cordons 0.39–0.63 mm lineally. Cervical papillae simple in male, bi- or tricuspid in female. Pharynx 92–140 μ long. Anterior muscular esophagus 0.46–0.66 × 0.061–0.067 mm, posterior glandular 1.54–2.17 × 0.098–0.19 mm. Tail conical, 0.28–0.39 mm long in male, up to 0.14 mm long in female. Anal papillae pedunculate, 4 preanal and 4 postanal pairs, besides two small papillae just in front of tail end. Left spicule slender, 0.39–0.49 mm long, right navicular, 0.15–0.16 mm long. Vulva dividing body length in ratio of 3.0–4.4 : 1. Eggs embryonated when deposited, 39–42 × 22–25 μ.

Habitat. Esophagus and proventriculus of *Emberiza spodocephala personata* (Temm.).

Locality and date Sizuoka Prefecture; February 1, 1933.

Type and paratypes in my collection.

18. *Dispharynx capitata* (Molin, 1860) Cram, 1927

A single adult male from the esophagus of *Otus bakkamoena semitorques* Temm. et Schleg. The original description of this species being based on the female only, the identification of my specimen must be looked upon as provisional.

The body is 8.57 mm long by 0.275 mm broad and spirally coiled posteriorly. The undulating descending cordons are 315 μ long and the not anastomosing ascending ones about half as long. The bicuspid postcervical papillae lie 0.35 mm, and the anterior margin of the nerve ring 0.216 mm, from the head end. The mouth has two very small papilliform lips. The narrow tubular pharynx is 174 μ long. The anterior muscular portion of the esophagus is 0.627 mm long and the broader posterior glandular portion 2.48 mm long. The well developed caudal alae have 4 pairs of preanal and 5 pairs of postanal papillae. The longer spicule is about 0.42 mm long and the shorter 0.16 mm long.

LITERATURE CITED

Cram, E. B. Bird parasites of the nematode suborders Strongylata, Ascaridata, and Spirurata. U. S. Nat. Mus. Bull., 140, 1927, p. 240.

19. *Synhimantus groffi* Li, 1934

A single female was found in the stomach of *Nycticorax nycticorax nycticorax* (Linné), a new host for the species, from Lake Ogura. The body with a thick, transversely striated cuticle is 6.3 mm long by 0.25 mm broad. The spinous cordons, 27 μ in maximum breadth, extend for about 0.27 mm back from the head end, and the recurrent portions unite with each other about 0.1 mm behind

*Cram, l. c., p. 243.

the head. The tridentate cervical papillae behind the cordons measure 75 μ anteroposteriorly. The nerve ring lies 42 μ from the anterior end of the esophagus. The straight pharynx is 0.15 mm long by 15 μ broad. The somewhat sinuous, anterior muscular part of the esophagus is 0.63 mm long, while the broader posterior glandular part is 2.4 mm long and has a valvular appendix at its posterior end. The stumpy conical tail is 54 μ long, and the vulva lies about 45 μ in front of the anus. The ellipsoidal, thin-shelled eggs are 18–20 × 10–12 μ; the contained ovum is not segmented.

Litetature cited

Li, H. C. Report on a collection of parasitic nematodes, mainly from North China. Part II. Spiruroidea. Trans. Amer. Micr. Soc., Vol. 53, No. 2, 1934, p. 186–187.

20. *Cosmocephalus capellae* n. sp.

Description. One male and two female adults, one of which was damaged during the dissection of the host, were found in the stomach contents of *Capella* (*C.*) *gallinago gallinago* (Linné) deposited in the museum of the Zoological Department of the Imperial University of Kyoto. The body measures 5.1 × 0.17mm in the male and 5.0 × 0.22 mm in the female, and is attenuated toward both ends. The cuticle is thick and finely striated transversely, but the apparent longitudinal striations are due to subcuticular muscle fibers. The cordons, reaching backward to 0.26–0.3 mm from the anterior extremity, are straight and each forms in front a narrow loop directed toward the junction of the two recurrent portions, which lies about 75 μ from the head end. The two lateral lips have each a prominent tooth-like projection at the

Fig. 36

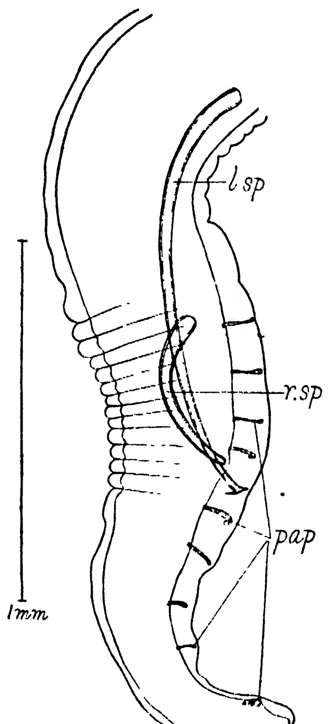

Fig. 35

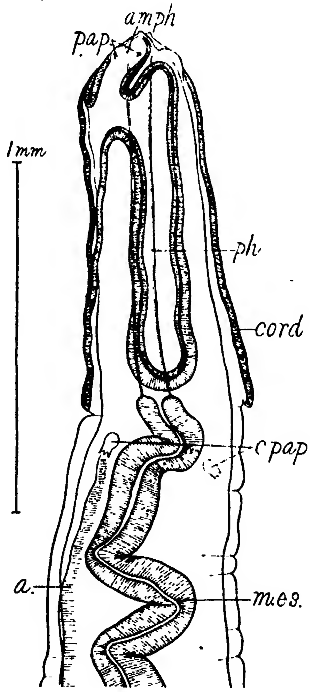

Fig. 35–36. *Cosmocephalus capellae.*
Fig. 35. Anterior extremity of female; ventrolateral view.
Fig. 36. Posterior extremity of male; lateral view.

middle, and two submedian papillae besides an amphid at the base. In the median line there is a dorsal and a ventral large rounded process between the origins of the loops mentioned above. The cervical papillae behind the cordons are tricuspid in the male but bicuspid in the female. The lateral flanges arising immediately behind the cervical papillae terminate in the female at about the level of the beginning of the intestine but extend further backwards in the male.

The cylindrical pharynx is about 0.25 mm long. The sinuous anterior muscular esophagus, 0.47–0.5 mm long, begins just behind the posterior end of the cordons; the broader posterior glandular esophagus is 1.62–1.85 mm long.

The tail of the male, 0.24 mm long, is curved ventrad and terminates in a blunt point. The caudal alae, about 30 μ broad, are supported by 4 preanal and 5 postanal pairs of costiform papillae, of which the smallest posteriormost pair lies near the tail tip, with two pairs of small sessile papillae between. The longer spicule is 0.35 mm long and has a double barb at the distal end, while the shorter arcuate one is 0.123 mm long and truncate at the end.

The conical tail of the female, 0.1 mm long, has a pair of small lateral papillae near its end with a rounded button at the tip. The vulva lies at the posterior end of the esophagus, dividing the body length in the ratio of 2.36 : 2.66. The elliptical, thick-shelled, embryonated eggs measure 39–42 × 21–24 μ in the mounted condition.

DISCUSSION. This species differs from the closely related *C. obvelatus* (Crepl., 1825) and *C. imperialis* Morishita, 1930, in the length of spicules, in the size of eggs, etc.

Cosmocephalus capellae n. sp.

SPECIFIC DIAGNOSIS. *Cosmocephalus* Molin, 1858. Body 5.1 × 0.17 mm* in male, 5.0 × 0.22 mm in female, with a dorsal and a ventral rounded process between anterior ends of cordons. Cordons 0.26–0.3 mm long, with straight edges. Cervical papillae bi- or tricuspid. Lateral alae terminating at beginning of intestine in female but extending further backwards in male. Pharynx about 0.25 mm long. Anterior muscular part of esophagus 0.47–0.5 mm long, posterior glandular part 1.62-1.85 mm long. Tail 0.24 mm long, with blunt tip in male, but 0.1 mm long, conical, with a rounded terminal button in female. Anal papillae pedunculated, 4 preanal and 7 postanal pairs, the last three lying close to tail tip. Longer spicule 0.35 mm long, with barbs at distal end; shorter one 0.123 mm long, truncate at end. Vulva at posterior end of esophagus. Eggs 39–42 × 21–24 μ.

Habitat. Stomach of *Capella (C.) gallinago gallinago* (Linné).

Locality. Kyûsyû.

Type in my collection.

LITERATURE CITED

Morishita, K. Two nematode parasites of the guillemot. Japan. Jour. Zool., Vol. 3, No. 1, 1930, p. 67–70

*This is subject to later emendation.

21. *Echinuria cincli* n. sp.

Three gravid females were found on January 18, 1934, in the proventriculus of *Cinclus pallasi pallasi* (Temm.). The body, 3.56–4.06 × 0.16–0.196 mm, is finely striated transversely. The mouth has two simple prominent triangular lateral lips. The cordons, measuring 61–73 μ longitudinally and

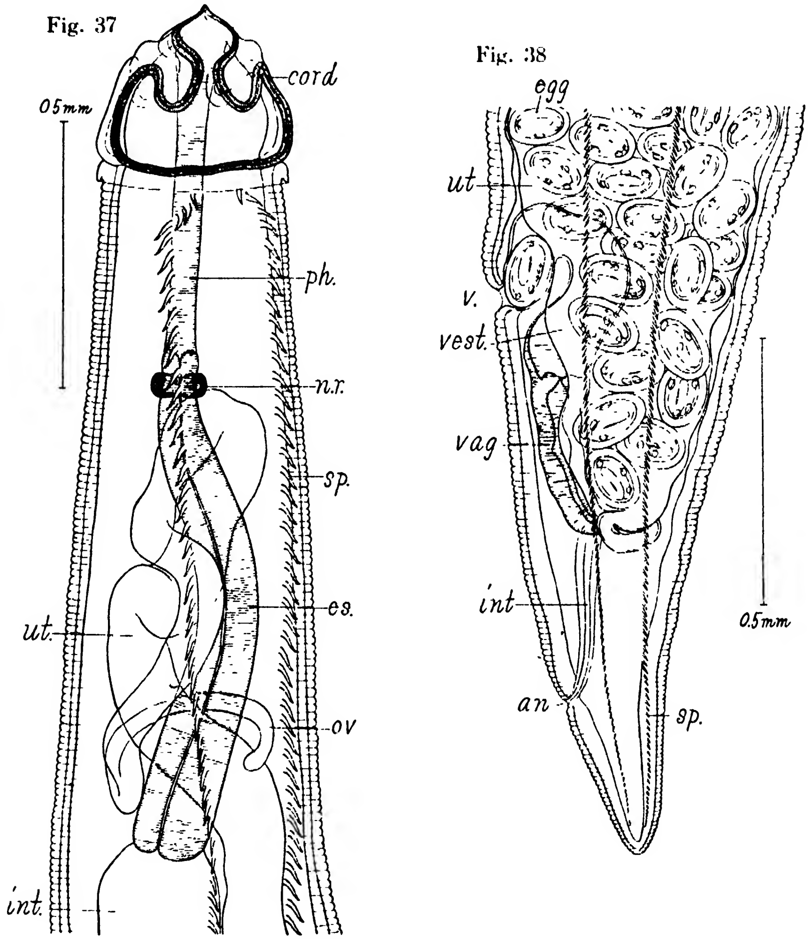

Fig. 37–38. *Echinuria cincli*.
Fig. 37. Anterior extremity of female; lateral view.
Fig. 38. Posterior extremity of female; lateral view.

anastomosing posteriorly in the lateral fields, appear double and are without any armature, each one having two marked infoldings as shown in fig. 37. Directly behind the cordons there is a distinct circular cuticular fold. The two lateral rows of sharp, backwardly pointed spines up to 20 μ long form directly behind the cuticular ring mentioned above an interrupted arch and gradually

approach each other as they proceed backwards to the pointed tail end. The narrow cylindrical pharynx, 0.14 mm long, is surrounded by very fine circular muscle fibers. The anterior muscular portion of the esophagus is 0.17–0.25 mm long by 28–34 μ broad and the posterior glandular 0.88–1.05 mm long by 42–61 μ broad. The anus opens about 70 μ from the tail end. The nerve ring lies just behind the anterior end of the esophagus.

The single, more or less twisted ovary is continued forwards into the wide germiduct, which turns back on itself at the anterior muscular part of the esophagus. The voluminous uterus, distended with eggs, occupies the entire breadth of the body, and gives rise about midway between the anus and the vulva to a muscular vagina, which is continued forwards into a vestibule. The vulva lies 0.257–0.28 mm from the tail end. The elongate oval, thick-shelled, embryonated eggs are 36–38 μ long by 22–26 μ broad.

DISCUSSION. This species resembles *Echinuria horrida* (Rudolphi, 1809) Cram, 1927, so closely that a cursory examination may mislead one. The chief differences are body size and egg length.

The specific diagnosis is reserved until adult males are obtained.

LITERATURE CITED

Cram, E. B. Bird parasites of the nematode suborders Strongylata, Ascaridata, and Spirurata. Bull. U. S. Nat Mus., 140, 1927, p. 241–258

PHYSALOPTERIDAE Leiper, 1908

22. *Streptocara recta* (Linstow, 1879) Skrjabin, 1916

One male and four gravid females were found in the submucosa of the stomach of *Podiceps ruficollis japonicus* Hartert from Lake Biwa. Though markedly different in size, they agree well with *Streptocara recta* (Linstow, 1879) anatomically; hence the above identification.

The anteriorly tapering body is 4 mm long by 0.126 mm broad in the male and 6.7 mm by 0.21 mm broad in the female. The cuticle is very finely striated transversely. The mouth has two small lips but no papillae. The collarette has very fine marginal teeth. The cervical papillae, about 45 μ from the head end, are 5-pointed. In the female the nerve ring lies 0.16 mm from the head end and the esophagus is 1.75 mm long. The tail is 61 μ long in the male and 45 μ long in the female.

The caudal alae with fine cross-striations are 98 μ across. There are 4 pairs of preanal and 7 pairs of postanal papillae, the last two pairs lying closely tandem between the posteriormost pair. The dissimilar spicules are alate along their entire length; the longer one ending in a barb is 294 μ long and the shorter about 60 μ long.

The vulva, lying about three fifths the body length from the head end, leads directly into a fairly wide vestibule, from the posterior end of which the

straight muscular vagina runs backwards. The ellipsoidal, thick-shelled, embryonated eggs are 33–36 μ long by 17–20 μ broad.

TETRAMERIDAE Travassos, 1914

23. *Tetrameres scolopacis* n. sp.

DESCRIPTION. Several gravid females from the proventriculus of *Scolopax rusticola rusticola* from Sizuoka Prefecture.

Fig. 39

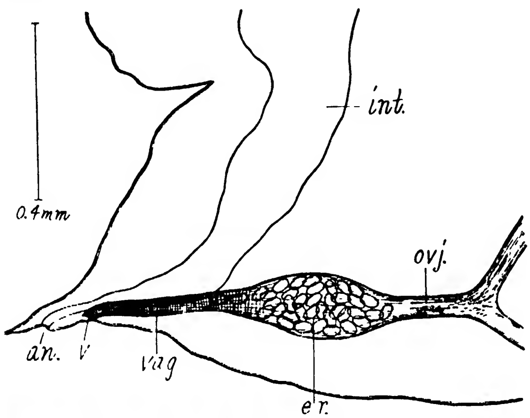

Fig. 40

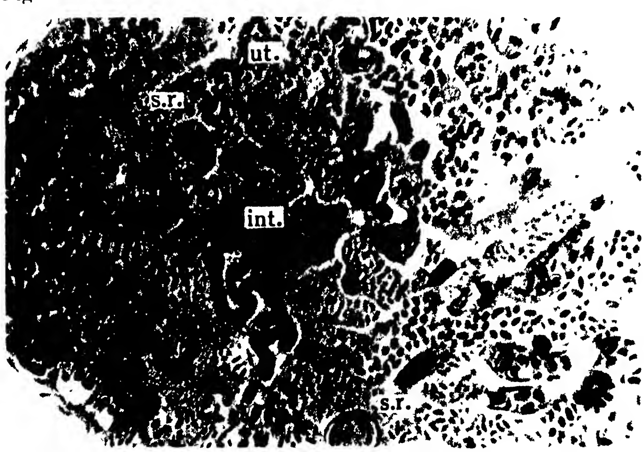

Fig. 39–40. *Tetrameres scolopacis*.
Fig. 39. Posterior extremity of female; lateral view.
Fig. 40. Transverse section of female through two seminal receptacles.

The globular body, up to 1.6 mm in diameter and with prominent conical extremities, is divided into quadrants by two median and two lateral longitudinal furrows. The thin cuticle is very finely striated transversely. The short buccal capsule is about 8 μ in diameter. The esophagus, 0.98 mm long and 84 μ broad at the posterior end, contains a glandular tissue in its greater posterior part. The black voluminous intestine, 2.8 mm long, tapers posteriorly and opens 84 μ from the acute tail end.

The two long convoluted ovaries are up to 50 μ broad. There is a pyriform receptaculum seminis about 0.15 mm in diameter at the proximal end of each strongly convoluted uterus. The Y-shaped, longitudinally striated ovijector forms a fusiform swelling filled with eggs at a distance of 0.4 mm from the vulva, which lies 0.11 mm in front of the anus. There is no copulatory receptaculum of Cram. The ellipsoidal,

thick-shelled, embryonated eggs are slightly flattened at the poles and measure 46 μ long by 28 μ broad.

DISCUSSION. This species resembles *Tetrameres micropenis* Travassos*, 1915, more closely than any other known members of the genus but differs from it distinctly in egg size.

The specific diagnosis is reserved until adult males are available.

DIOCTOPHYMIDAE Railliet, 1915

24. *Eustrongylides elegans* (Olfers, 1816) Jägersk., 1909

One male, 22.3 × 0.4 mm, and two not yet fully matured females, up to 49.5 × 1.3 mm, were found in the wall of the proventriculus of *Podiceps ruficollis japonicus* Hartert from Lake Biwa.

As pointed out and figured by Jägerskiöld, the body is broadest at the greater middle part and has a fusiform swelling, more pronounced in the female, in the esophageal region and at the posterior extremity. In the larger female the cuticle is only 5 μ thick at the middle of the body but becomes gradually thicker (up to 30 μ) toward the extremities, which are coarsely cross-striated. The nerve ring lies just behind the anterior end of the esophagus. The mouth is bounded by two not very prominent lips, each with a cuticular spine at the middle. Four similar spinous projections with a papilliform basal pulp lie in the submedian planes and form with the two lip spines an inner circle. The outer circle is formed by six large prominent papillae lying in line with the members of the inner circle. The buccal cavity is 0.12 mm long. The esophagus, broader posteriorly, is 7.13 mm long in the male and 11.88 mm in the larger female, and has at the posterior end a valvular appendix up to 0.15 mm long by 0.26 mm broad and projecting into the intestine. The distinctly differentiated rectum, about 0.5 mm long, opens at the truncate posterior end of the body.

The male has a bell-shaped muscular bursa 0.24 mm in diameter and opening ventroterminally. The long slender spicule could not be measured accurately. The vagina with a thick muscular wall is very densely beset with cuticular bosses. The vulva opens terminally by the side of the anus.

E. tricolor Sugimoto, 1931, from the proventriculus of a Formosan domestic duck is probably identical with the present species.

LITERATURE CITED

Jägerskiöld, L. A. Zur Kenntnis der Nematodengattung *Eustrongylides* und *Hystrichis*. Nova acta regiae societatis scientiarum upsaliensis, ser. IV, Vol. 2, No. 3, 1909, p. 10–17.

*Cited from Cram, l. c., p. 348.

TRICHURIDAE Railliet, 1915

25. *Capillaria retusa* (Raill., 1893) Travassos, 1915

Since Morgan has recently given a good description of this species in the the Journal of Helminthology, Vol. 10, p. 191–193, only some measurements will be given.

Male 9.1×0.057 mm; head 7μ broad; middle of nerve ring 72μ from head end; anterior region 4.88 mm long; spicule 1.06 mm long by 20μ broad at anterior end; spicular sheath faintly spinose, extruded for about 0.2 mm.

Female 16.4×0.09 mm; head 9μ broad; middle of nerve ring 84μ from head end; vulva dividing body length approximately as 5 : 11; eggs $51–57 \times 24–32 \mu$.

According to Morgan, the anterior region of the male is less than half as long as the whole body, but in my specimen it is longer.

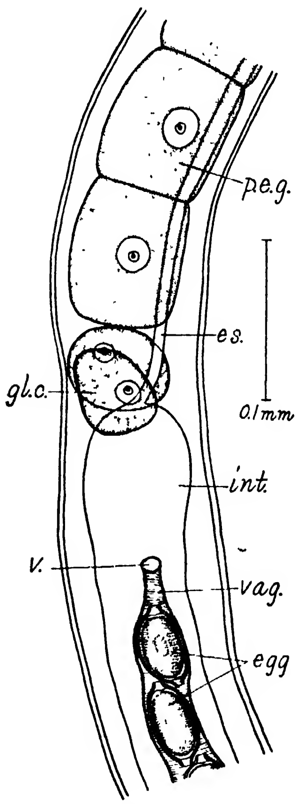

Fig. 41. Female *Capillaria vanelli* showing vulvar region.

26. *Capillaria vanelli* n. sp.

DESCRIPTION. Two gravid females from the esophagus of *Vanellus vanellus* (Linné) from Tottori Prefecture. The body is filiform, 22.68–23.35 mm long by 0.14–0.15 mm broad and faintly striated transversely. The pointed head is 11μ broad and the blunt tail $44–47 \mu$ broad. The anterior portion of the esophagus is 0.35–0.37 mm long; the posterior portion surrounded by 30–40 para-esophageal gland cells is 3.28–3.38 mm long. There are two large gland cells at the junction of the esophagus with the intestine. The latter is 19.04–19.6 mm long and opens subterminally.

The vulva lies about 0.14 mm behind the beginning of the intestine, about 5 times as far from the posterior extremity as from the anterior. The lemon-shaped eggs with polar plugs are 50–53 μ long by 23–25 μ broad.

The specific diagnosis is reserved until male adults are secured.

Abbreviations used in Figures

a. ala
amph. amphid
an. anus
app. appendix
b. c. buccal cavity
cord. cordon
c. pap. cervical papilla
d. l. dorsal lip
e. b. esophageal bulb
e. r. egg reservoir or vestibule
es. esophagus
gl. c. gland cell
g. d. germiduct
gl. es. glandular esophagus
gub. gubernaculum
i. l. interlabia
int. intestine
l. l. lateral lip
l. sp. left spicule
m. muscle
m. es. muscular esophagus
n. r. nerve ring
ov. ovary
ovj. ovijector
pap. papilla
p. e. g. para-esophageal gland
ph. pharynx
p. ov. posterior ovary
r. sp. right spicule
s. sucker
spic. spicule
s. m. l. submedian lip
s. r. seminal receptacle
s. v. l. subventral lip
t. tooth
test. testis
trid. trident
ut. uterus
v. vulva
vag. vagina
vent. ventriculus
vest. vestibule

Studies on the Helminth Fauna of Japan
Part 13. Mammalian Nematodes

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Laboratory of Parasitology, Kyoto Imperial University

CONTENTS

INTRODUCTION

All the mammalian nematodes dealt with in this paper, with the exception of one new species from the rat, another from the bat and a third from the hare, are already well known from other countries.

Thanks are due to the authorities of the Government Veterinary Research Station at Nisigahara, Tokyo, and of the Municipal Stockyard of Kyoto for their generous supply of materials.

ASCARIDAE Baird, 1853

1. *Toxocara canis* (Werner, 1782) Johnston, 1916

The body of this cosmopolitan dog ascarid is up to 100 × 1.5 mm in the male and 170 × 2.5 mm in the female. The head is 0.35–0.38 mm broad. The lips, 0.15–0.21 mm long, are perfectly similar in structure to those of *T. mystax* described below. The excretory pore lies at or just behind the nerve ring, 1.1–1.3 mm from the head end. The cervical alae are up to 5.0 mm long.

The tail of the male is 0.26–0.3 mm long and constricted in front of its middle. The preanal papillae vary in number from 17 to 22, but there are constantly 6 pairs of postanals, of which the first are double and lie directly behind the cloacal aperture, while the others are simple and lie behind the constriction in two submedian and three lateral groups. The alate spicules are 1.3 mm in maximum length.

The conical tail of the female, up to 0.9 mm long, bears a pair of lateral papillae, as in *T. mystax*. The vulva lies about one fifth the body length from the anterior extremity. The globular to oval, thick-shelled eggs with reticulate surface are 70–90 × 60–75 μ; the embryos are formed in about 15 days at 27°C.

2. *Toxocara mystax* (Zeder, 1800)

The body of this common cat nematode with thick, transversely striated cuticle is up to 68 × 1.0 mm in the male and 125 × 2.0 mm in the female, the head being 0.21–0.35 mm broad. The three prominent lips, 0.12–0.18 mm long, are denticulated at the margin and contain each two claw-like pulp masses; on the dorsal lip are two large submedian papillae with a double nerve ending, while on each subventral lip are only one similar papilla and two smaller ones, one of which is rudimentary. The nerve ring and the excretory pore lie at about the same level, 0.58–0.96 mm from the head end. The cervical alae are 1.8–3.0 mm long. The esophagus, 2.6–4.8 × 0.22–0.43 mm, forms at its anterior end three conical tooth-like processes projecting into the mouth cavity, and contains on the dorsal side an esophageal gland extending from its posterior to near its anterior end. The glandular ventriculus is 0.3–0.5 × 0.2–0.36 mm and has an annular appendix at its posterior end.

The tail of the male, 0.13–0.23 mm long, has in front of its middle a

distinct constriction, which is more pronounced on the ventral side than on the dorsal. The preanal papillae are in 17–20 pairs. Immediately behind the cloacal aperture there is a large double subventral papilla on each side, and on the posterior part of the tail behind the constriction are five pairs of papillae, two being submedian and the other three lateral. The alate spicules are up to 2.2 mm long.

The conical tail of the female is 0.43–0.65 mm long and bears a pair of minute lateral papillae near its tip. The vulva divides the body length in the ratio of 1 : 3.4–4.4. The subglobular, thick-shelled eggs with reticulate surface are 66–84 × 51-69 μ; the contained ova become embryonated in about 15 days at 27°C.

This species differs from the closely related *T. canis* chiefly in body size and in the length of spicules.

HETERAKIDAE Railliet et Henry, 1914

3. *Ganguleterakis spumosa* (Schneider, 1866) Lane, 1917

This worm was found in the large intestine and cecum of *Rattus rattus alexandrinus* (Geoffroy), *R. norvegicus norvegicus* (Erxleben) and *R. norvegicus* var. *albus* Fitzinger.

The body with very finely cross-striated cuticle is 6.2–8.6 × 0.22–0.3 mm in the male and 8.5–11.9 × 0.28–0.38 mm in the female. The head is 70–105 μ broad. The lateral flanges begin 0.12–0.18 mm behind the head end. The nerve ring, the excretory pore and the cervical papillae lie 0.3–0.38 mm, 0.3–0.41 mm and 0.32–0.43 mm respectively from the head end. The three lips of the mouth have each two papillae. The pharynx, 45–69 × 36–51 μ, has at its anterior end three pyramidal chitinous teeth projecting into the mouth. The cylindrical anterior muscular part of the club-shaped esophagus is 0.41–0.58 mm long in the male and 0.46–0.63 mm long in the female: the posterior glandular swelling containing a valvular apparatus is 0.2–0.26 × 0.14–0.18 mm in the male and 0.25–0.3 × 0.15–0.21 mm in the female.

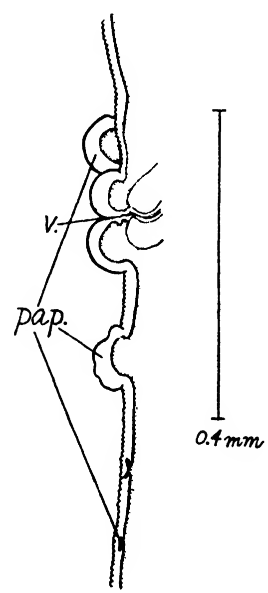

Fig. 1. Vulvar region of *Ganguleterakis spumosa* (Schneider, 1866) showing bosses.

The tail of the male is 0.3–0.35 mm long and has a sharp tip. The ten pairs of caudal papillae are arranged just as shown by Yorke and Maplestone (1926, fig. 147), but the eighth pair is very small and lies just anterolateral to the ninth. The precloacal sucker with a median notch on its posterior border measures 66–87 μ anteroposteriorly. The two similar spicules are 0.27–0.315 mm long. The tail of the

female is 0.65–0.92 mm long.

The prominent vulva with thick lips lies at or just behind the middle of the body but may be sometimes in front of it. In fully developed females there are behind the vulva constantly one to three conspicuous papilliform bosses lying one behind the other at more or less irregular intervals; the posterior one or two are usually smaller or rudimentary. In front of the vulva a similar boss may be found occasionally, but when present it is always as large as or even slightly larger than the first postvulvar one. The oral, thick-shelled eggs with reticulate surface are 63–70 μ long by 45–50 μ broad; the contained ova are not segmented.

Oxyuridae Cobbold, 1864

4. *Enterobius muris* n. sp.

Description. A number of females were found in the large intestine of *Rattus norvegicus* var. *albus* Fitzinger. The posteriorly pointed body is 2.2–2.93 mm long by 0.2–0.25 mm broad at about the middle. The cuticle is

Fig. 2

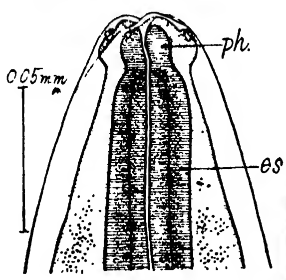

Fig. 3

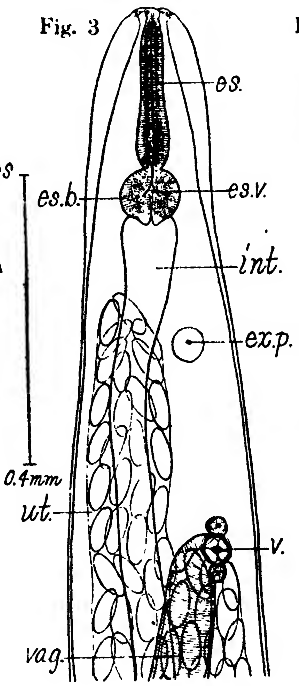

Fig. 4

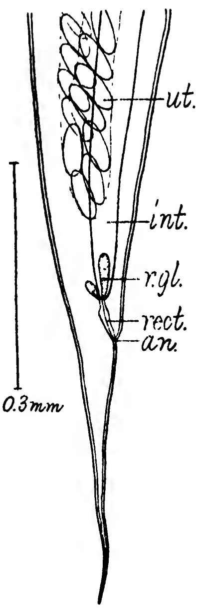

Fig. 2–4. ***Enterobius muris.***
Fig. 2. Anterior extremity of female; dorsal view.
Fig. 3. Anterior part of female; ventral view.
Fig. 4. Posterior extremity of female; lateral view.

finely striated longitudinally and forms at the anterior end of the body a conspicuous inflation having the largest dorsoventral dimension. There are no lateral alae. The excretory pore surrounded by a clear vesicle lies 0.4–0.48 mm

from the head end. Of the three mouth lips the two subventral ones contain each a peculiar papilliform structure not projecting beyond the cuticle, while the dorsal contains two similar structures, one on either side. The esophagus is almost cylindrical or club-shaped and measures 188–210 μ in length; it is followed by a glandular bulb, which is 66–80 μ in diameter, contains a valvular apparatus and has three rudimentary lobes at the posterior end. The pointed tail is 0.32–0.35 mm long.

The not prominent vulva divides the body length in the ratio of 1 : 2.6–2.9. Directly in front of and behind the vulva there is a mass of gland cells. The backwardly directed vagina is lined for about 0.1 mm or more by a very thick cuticle, which appears in optical section to be divided into quadrants, and is surrounded by well developed circular muscle fibers. The long ovijector continues posteriorly and does not form a pyriform reservoir with the vagina. The uterus may extend as far forwards as the esophageal bulb, but terminates posteriorly in every instance short of the anus. The asymmetrically elliptical, thin-shelled eggs, 72–78 μ long by 30–36 μ broad, are not yet fully embryonated; as in *Enterobius vermicularis*, there is inside the shell proper a thin membrane with an albuminous substance on its outer surface.

DISCUSSION. Although the male is unknown, it is certain that this species is very closely related to *Enterobius vermicularis* (Linné, 1758), from which however it differs fundamentally in having four submedian head papillae and no lateral alae. These differences may be of generic importance, but I would refer my species for the present to *Enterobius* Leach, 1853.

Enterobius muris n. sp.

SPECIFIC DIAGNOSIS. *Enterobius* Leach, 1853. Male unknown. Female up to 3.0 mm long by 0.25 mm broad. Cuticle finely striated longitudinally. Lateral alae absent. Head with dorsoventrally elongate vesicular expansions of cuticle, less conspicuous behind esophageal bulb. Subventral lips with one papilla each, dorsal with two. Excretory pore 0.4–0.48 mm from head end. Tail pointed, 0.32–0.35 mm long. Vulva dividing body length in ratio of 1:2.6–2.9. Ovijector long, not forming egg reservoir. Eggs 72–78 × 30–36 μ.

Habitat. Large intestine of *Rattus norvegicus* var. *albus*.

Locality. Kyoto.

Type and paratypes in my collection.

5. *Aspiculuris tetraptera* (Nitzsch, 1821)

This species occurred in the large intestine and cecum of *Rattus rattus alexandrinus* (Geoffr.) and *Mus molossinus molossinus* Temm. et Schleg.

The following supplementary note is based on two males and six females from a rat captured at my former residence at Hanazono, Kyoto. The body measures 2.15–2.7 × 0.1–0.11 mm in the male and 2.7–4.27 × 0.15–0.21 mm in the female. The transverse striations are much more pronounced on the subcuticle than on the cuticle. The lateral cervical alae arising from the vesicular expansion of the head cuticle are 0.28–0.35 mm long and 0.15–0.17 mm

across in the male, while in the female it is 0.28–0.4 mm long and 0.16–0.24 mm across. The three lips of the mouth bear each two rounded papillae. The nerve ring lies 0.08–0.14 mm from the head end and the cervical papillae just behind it. The excretory duct opens at the junction of the two parts of the esophagus. The anterior muscular part of the esophagus, $0.18–0.19 \times 0.033–0.039$ mm in the male and $0.21–0.24 \times 0.042–0.048$ mm in the female, is slightly enlarged at both ends; the bulbous posterior glandular part containing a valvular apparatus is $0.1–0.12 \times 0.066–0.08$ mm in the male and $0.12–0.156 \times 0.084–0.106$ mm in the female.

In the male, the narrow lateral flange of the body is continued into the conical tail, which is 0.12–0.2 mm long and bears dorsally at its tip a vesicular swelling of the cuticle. I have been unable to observe three distinct portions of the caudal alae. Of the seven pairs of anal papillae, one is directly preanal, two are adanal, and the rest postanal. The first and second pairs of postanal papillae lie directly behind the anus; the third lies near the median line about midway between the second and the fourth; the latter is just medial to the lateral flange, about 60 μ from the tail tip. There is a circumscribed median cuticular thickening in front of the cloacal aperture. The spicules and gubernaculum are absent.

The pointed tail of the female is 0.28–0.5 mm long. The two ovaries begin some distance behind the esophageal bulb and proceed backwards almost parallel to each other. The gravid uterus extends further backwards than the anus. The muscular vagina proceeds forwards from the vulva for a short distance and then turns backwards. The vulva divides the body length in the ratio of 1 : 1.45–1.6. The ellipsoidal, thin-shelled eggs are 81–90 μ long by 42–51 μ broad; the embryo is in the morula stage.

Strongylidae Baird, 1853

6. *Strongylus edentatus* (Looss, 1900) Railliet et Henry, 1909

Some ten mature females from a horse slaughtered at the Government Veterinary Research Station at Nisigahara, Tokyo, enable me to make the following additions to Looss' original description.

The robust body is 34–38.4 mm long by 1.5–2.0 mm broad. The four submedian papillae of the mouth collar project outwards with sharp tips; the two dorsal lie a little farther apart (0.38–0.45 mm) from the lateral amphids than the two ventral (0.3–0.38 mm), so that the two dorsal submedian papillae (0.52–0.63 mm) are always closer together than the two ventral submedian ones (0.57–0.64 mm). The filaments of the external leaf-crown are not over 200. The duct of the dorsal esophageal gland opens in the middorsal line about 0.06 mm behind the anterior margin of the buccal capsule, and is, contrary to Looss' statement, always straight. The blunt tail of the female is 0.4–0.5 mm long. The vulva divides the body length in the proportion of 2.4–2.65 : 1. The ellipsoidal, thin-shelled uterine eggs as fixed in alcohol and

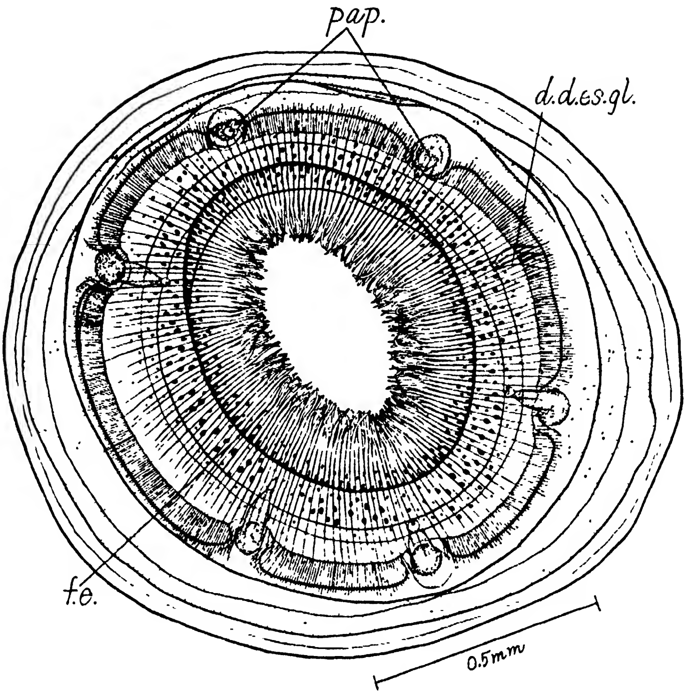

Fig. 5. Head of female *Strongylus edentatus* (Looss, 1900); end-on view.

measured in water are 60–81 × 33–45 μ; the contained ovum is in 1–4 or more cell stage.

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7. *Oesophagostomum dentatum* (Rudolphi, 1803) Molin, 1861

Three mature males and seven not fully gravid females from the large intestine of a pig slaughtered at the Government Veterinary Research Station at Nisigahara. The body, with relatively thick, transversely striated cuticle, is 8.12–8.68 × 0.36–0.42 mm in the male and 8.0–10.7 × 0.39–0.45 mm in the female. The mouth collar bears four pointed submedian papillae and two less prominent lateral amphids. There is a single leaf-crown 17–19 μ long by 8–11 μ wide in front. The ventral transverse groove delimiting

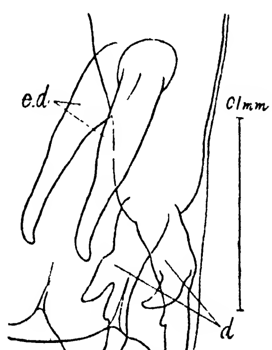

Fig. 6. Part of bursa of *Oesophagostomum dentatum* (Rud., 1803) showing externodorsal and dorsal rays.

the cervical vesicle lies 0.14–0.23 mm from the head end. The lateral papillae lie at the posterior swelling of the esophagus, which is 0.35–0.42 mm long by 0.08–0.15 mm broad.

The two spicules are 0.88–1.1 mm long. The gubernaculum is present. The bifurcated dorsal ray of the bursa has two lateral twigs, the distal one being much smaller.

The sharply pointed tail of the female is 0.23–0.53 mm long. The vulva lies 0.3–0.49 mm in front of the anus. The ellipsoidal, thin-shelled eggs are 61–70 × 36–42 μ; the contained ovum is segmented.

8. *Oesophagostomum radiatum* (Rudolphi, 1803) Raill., 1898

Syn. *Bosicola tricollaris* Sandground, 1929

The following note is based on two males and as many females, all adult, from the large intestine of cattle belonging to the Government Veterinary Research Station at Nisigahara.

The males are 11.55–15.2 × 0.36–0.48 mm and the females 19.3–20.2 × 0.4–0.58 mm. There are two lateral flanges extending from behind the cephalic vesicle to the posterior extremity of the body. The cervical papillae lie 0.35–0.38 mm from the head end. The excretory duct opens under the posterior border of the cervical vesicle, 0.29–0.33 mm from the head end. The mouth collar, 140–170 μ broad, is very distinctly constricted off from the broader cervical vesicle, which usually also has a constriction behind its middle. The single leaf crown is wider than in *O. dentatum* (Rud.). At the anterior end of the esophagus 0.68–0.98 mm long by 0.12–0.16 mm broad there are three chitinous teeth or lancets 61–67 μ long.

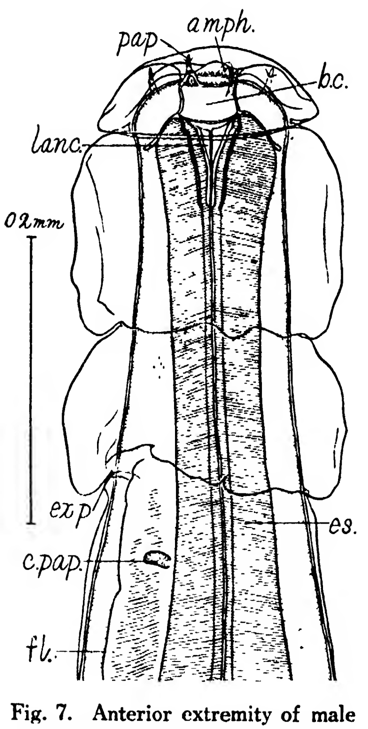

Fig. 7. Anterior extremity of male *Oesophagostomum radiatum* (Rud., 1803); lateral view.

The blunt-tipped spicules are 0.74–0.84 mm long. The ventral ray of the bursa is cleft in its distal half; the externolateral is separate from the mediolateral, which is fused proximally with the posterolateral; the externodorsal arises from a common trunk with the bifurcate dorsal, which immediately subdivides into four branches and gives off a very slender accessory twig usually from the inner branch of each side but occasionally also from the outer.

The pointed tail of the female is 0.36–0.4 mm. The very prominent vulva lies 0.56–0.75 mm in front of the anus. The ellipsoidal, thin-shelled eggs as

fixed in alcohol and measured in water are 87–98 × 44–53 μ; the ova are segmented before birth.

9. *Oesophagostomum sikae* Cameron et Parnell, 1933

The following note is to supplement the description by Cameron and Parnell, which is based on six females only. The material at my disposal consists of seven males and six females from the large intestine and cecum of *Sika nippon* shot near Kyoto.

The body is curved ventrad in the shape of a hook at the anterior part, and measures 9.95–12.0 × 0.32–0.36 mm in the male and 12.9–17.25 × 0.35–0.45 mm in the female. The cuticle has very fine longitudinal and transverse

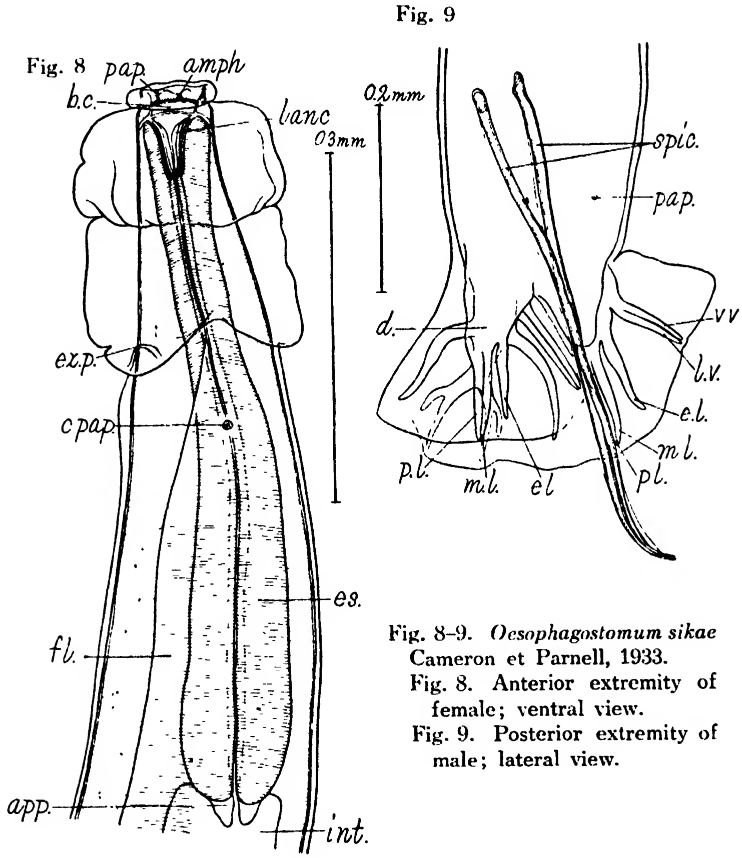

Fig. 8–9. *Oesophagostomum sikae* Cameron et Parnell, 1933.
Fig. 8. Anterior extremity of female; ventral view.
Fig. 9. Posterior extremity of male; lateral view.

striations. The mouth collar with two lateral amphids and four submedian papillae is 72–78 μ broad in the male and 78–87 μ broad in the female; its posterior edge is not so salient as in *Oesophagostomum radiatum* (Rud., 1803). The cervical vesicle is constricted in front of its middle; its posterior border covers up the excretory pore, which lies in the male 0.17–0.22 mm, and in

the female 0.18–0.25 mm, from the head end. The lateral flanges extend from immediately behind the lateral incision of the cervical vesicle to the posterior end of the body. The cervical papillae lie in the male 0.25–0.28 mm, and in the female 0.26–0.31 mm, from the head end. As in *O. radiatum*, the anterior border of the relatively shallow buccal capsule is finely denticulated, and the esophageal funnel has three lancets. The elongate club-shaped esophagus is 0.58–0.63 × 0.09–0.11 mm in the male and 0.62–0.7 × 0.11–0.13 mm in the female.

The dorsal lobe of the bursa is marked off from the lateral lobes by a slight notch at the end of the outer terminal branch of the dorsal ray, and may sometimes have a median fold. In front of the bursa there is a pair of lateral papillae. The ventroventral and lateroventral rays are close together; the mediolateral and posterolateral rays are parallel and arise from a broad common base. The arcuate externodorsal ray is given off from the trunk of the dorsal ray at about its middle; the longer inner terminal branch of each side has a minute slender twig near its base. The simple alate spicules are usually equal and similar and measure 0.55–0.6 mm in length but may be occasionally unequal, being 0.43 and 0.65 mm respectively. There is no gubernaculum.

The pointed tail of the female, 0.16–0.25 mm long, has a pair of small lateral papillae near its tip. The prominent vulva lies 0.56–0.76 mm in front of the anus. The elliptical, thin-shelled eggs containing four blastomeres are 69–81 μ long by 36–42 μ broad.

This species differs from the closely related *Oesophagostomum radiatum* (Rud., 1803) chiefly in body size, in the diameter of the mouth collar, in the length of spicules and in the size of eggs.

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Ancylostomatidae Nicoll, 1927

10. *Ancylostoma caninum* (Ercolani, 1859) Hall, 1913

This cosmopolitan species is so well known that I will only give mm measurements made on three males and two females.

Body 10–12 × 0.35–0.47 in male, 11–19 × 0.56–0.65 in female; buccal capsule 0.2–0.25 × 0.14–0.22; esophagus 0.88–1.06 × 0.13–0.21; nerve ring 0.56–0.65, cervical papillae 0.65–0.88, from head end; excretory pore usually just behind cervical papillae; spicules 0.65–1.02 long; vulva dividing body length in ratio of 1.6–2.0 : 1; tail in female 0.2–0.25 long.

Each branch of the dorsal ray terminates in two digitations in all the three specimens examined.

11. *Ancylostoma braziliense* Gomes de Faria, 1910

This species was originally reported from Brazilian *Felis domestica* and *Canis familiaris.* I have found it in the small intestine of *Nyctereutes procyonoides viverrinus* (Temm.) from the suburb of Kyoto.

The following note is based on three males and as many females.

The body with thick, transversely striated cuticle, is 6.75–8.31 × 0.3–0.32 mm in the male and 8.45–10 × 0.37–0.4 mm in the female. The head is bent dorsad and obliquely truncated. The buccal capsule, 0.138–0.175 × 0.11–0.13 mm in the male and 0.16–0.18 × 0.12–0.14 mm in the female, has on the ventral side two internal teeth and two pairs of stout marginal hooks, the inner of which

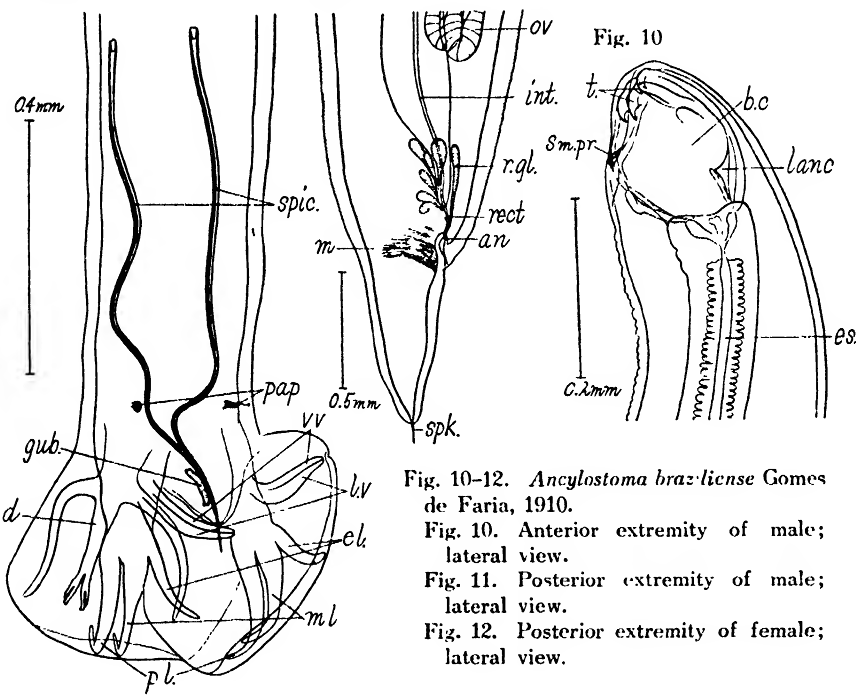

Fig. 10–12. *Ancylostoma braziliense* Gomes de Faria, 1910.
Fig. 10. Anterior extremity of male; lateral view.
Fig. 11. Posterior extremity of male; lateral view.
Fig. 12. Posterior extremity of female; lateral view.

is smaller than the outer. The paired tooth-like projections on the dorsal margin of the mouth are very prominent in four specimens out of six, but apparently lacking in the remaining two. The esophagus, slightly enlarged posteriorly, is 0.75–0.95 mm long by 0.098–0.125 mm broad, and its posterior valvular appendix is up to 45 μ long. The nerve ring, cervical papillae and excretory pore lie 0.38–0.5 mm, 0.55–0.61 mm and 0.56–0.65 mm respectively from the head end. There is a pair of conspicuous lateral papillae just in front of the bursa. The terminal branches of the dorsal ray are bidigitate, the inner digit being a little longer than the outer. The very slender equal spicules are 0.84–0.98 mm long. The strongly chitinized gubernaculum is 66–

70 μ long.

The elongate conical tail of the female with a terminal spike is about 0.18 mm long. The vulva lies at about the junction of the middle with the posterior third of the body. The opposed muscular ovijectors have each a thick cuticular tripartite valve near the proximal end. The ellipsoidal, thin-shelled, mature uterine eggs in the 4-cell stage as fixed in alcohol and measured in water are 63–66 × 36 μ.

12. *Strongylacantha rhinolophi* n. sp.

DESCRIPTION. Three males and three females, all adult, were found in the small intestine of *Rhinolophus cornutus cornutus* Temminck.

The slender body, 5.7–6.6 × 0.14–0.18 mm in the male and 6.3–10.44 × 0.14–0.2 mm in the female, is more or less strongly curved toward the ventral side at the anterior extremity. The cuticle is thin and exceedingly finely cross-striated. The excretory pore lies behind the nerve ring. In the female,

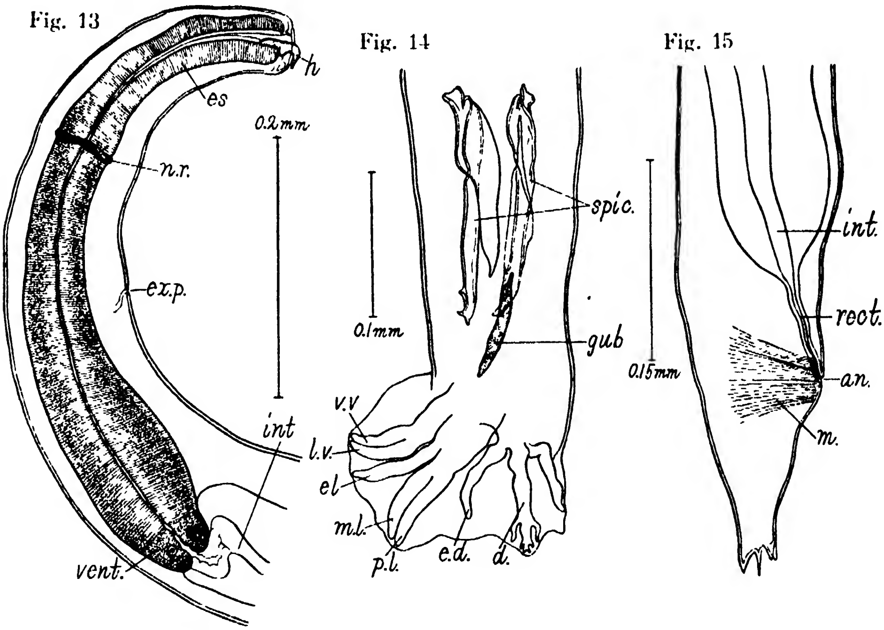

Fig. 13–15. *Strongylacantha rhinolophi.*
Fig. 13. Anterior extremity of male; lateral view.
Fig. 14. Posterior extremity of male; lateral view.
Fig. 15. Posterior extremity of female; lateral view.

the tail, 0.11–0.14 mm long, terminates in two subventral and a little larger dorsal points; directly ventral to the latter there is another slender process (spike) just as long.

The cuticular oral margin contains small chitinous fragments and several inconstant papilliform projections of the pulp. The two ventral chitinous hooks of the mouth are 34–39 μ long. The unpaired dorsal tooth is not conspicuous. The posteriorly enlarged esophagus containing glandular tissue is 0.5–0.59 mm long by 0.06–0.08 mm broad; its posterior end is differentiated into a glandular ventriculus.

The two spicules, 162–165 μ long, have each two ventral barbs near the posterior end, and a dorsal wing a little shorter than themselves. The simple gubernaculum with pointed ends is 78–95 μ long, and has a posterodorsally directed muscular band attached to its slender anterior end. The ventral ray of the bursa is cleft; the externolateral and laterals arise from a common trunk; the mediolateral and the posterolateral are close together; the externodorsal arises separately from the base of the dorsal, which ends in six small branches.

The female terminal genitalia are just as in *Trichostrongylus*. The vulva divides the body length in the proportion of 1.5–1.6 : 1. The elongate oval, thin-shelled eggs in the 4-cell stage when laid, are 86–95 μ long by 53–59 μ broad.

DISCUSSION. This species differs from *Strongylacantha glycirrhiza* van Beneden, 1873, chiefly in body size, and from *S. pretoriensis* Ortlepp, 1932, in the shape and size of the ventral oral hooks, in the length of the spicules, in egg size, etc. It is worth noting that the excretory pore lies in these two exotic species farther in front than in my species.

Strongylacantha rhinolophi n. sp.

SPECIFIC DIAGNOSIS. *Strongylacantha* van Beneden, 1873. Male 5.7–6.6×0.14–0.18 mm, female 6.3–10.44×0.14–0.2 mm. Excretory pore 0.29–0.32 mm from head end. Tail 0.11–0.14 mm long in female. Mouth hooks 34–39 μ long. Esophagus 0.5–0.59×0.06–0.08 mm. Spicules 162–165 μ long. Gubernaculum 78–95 μ long. Dorsal ray ending in 6 branches. Vulva dividing body length in ratio of 1.5–1.6:1. Eggs 86–95×53–59 μ.

Habitat. Small intestine of *Rhinolophus cornutus cornutus* Temm.

Locality and date. Hyôgo Prefecture; April 27, 1933.

Type and paratypes in my collection.

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13. *Globocephalus longemucronatus* Molin, 1861

This species was found associated with *Raillietostrongylus samoensis* (Lane, 1922) in the small intestine of *Sus leucomystax leucomystax* Temm. and *Sika nippon nippon* (Temm.) from the suburb of Kyoto.

The following measurements in mm were made on four males and six females.

MALE. Body 4.7–5.7 × 0.32–0.37; buccal capsule 0.15–0.16 × 0.1–0.126; esophagus 0.56–0.63 × 0.12–0.14; nerve ring 0.38–0.43 from head end; excretory pore and cervical papillae 0.44–0.48 from head end; spicules 0.69–0.72 long.

FEMALE. Body 5.75–6.8 × 0.37–0.43; buccal capsule 0.16–0.196 × 0.1–0.15; nerve ring 0.41–0.48 from head end; excretory pore and cervical papillae 0.43–0.53 from head end; tail 0.16–0.2 long; vulva dividing body length in ratio of 1.67–1.7 : 1.

The subventral lancets of the buccal capsule are so inconspicuous and rudimentary that they may easily escape observation. The important differences between this species and *Raillietostrongylus samoensis* (Lane, 1922) are given on p. 447. I have assured myself that these two species, regarded by Yorke and Maplestone as possibly identical, are distinct.

Fig. 16

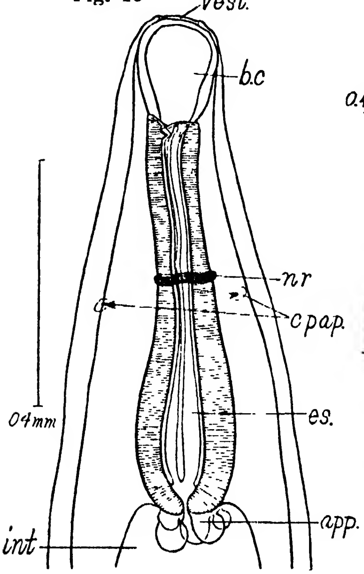


Fig. 17

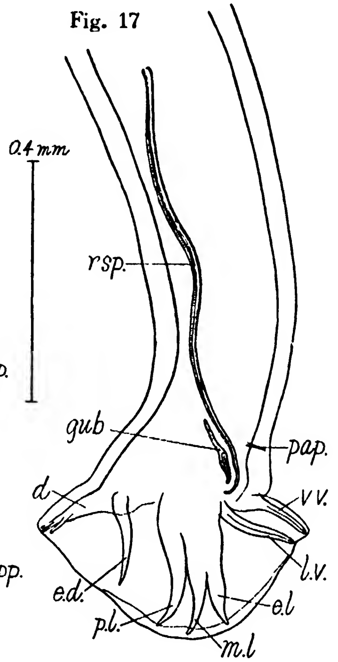


Fig. 16-17. *Globocephalus longemucronatus* Molin, 1861.
Fig. 16. Anterior extremity of male; dorsal view.
Fig. 17. Posterior extremity of male; lateral view.

14. *Raillietostrongylus samoensis* (Lane, 1922) Lane, 1923

As already stated this worm was found in the same hosts with the preceding species.

Measurements in mm on three males and four females are as follows.

MALE. Body 5.07–6.24 × 0.37; buccal capsule 0.13–0.17 in diameter; esophagus 0.62–0.67 × 0.12–0.15; nerve ring about 0.4 from head end; excretory pore 0.48–0.56, cervical papillae 0.5–0.58, from head end; spicules 0.4–0.48 long.

FEMALE. Body 6.18–6.44 × 0.5; buccal capsule 0.15–0.22 in diameter; esophagus 0.62–0.71 × 0.13–0.18; nerve ring 0.44–0.56 from head end; excretory pore 0.51–0.66, cervical papillae 0.53–0.66, from head end; tail 0.075–0.1 long; vulva dividing body length as 1.64–1.87 : 1.

Fig. 18

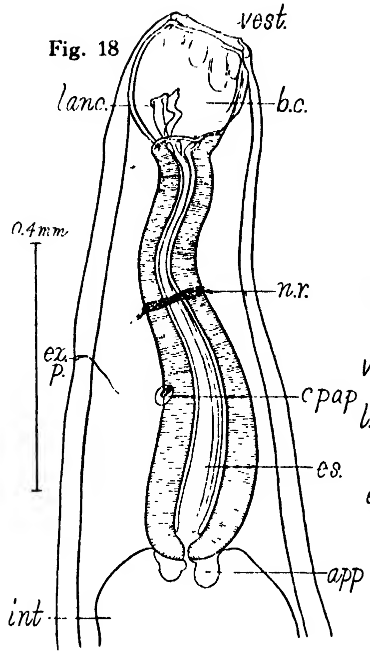


Fig. 19

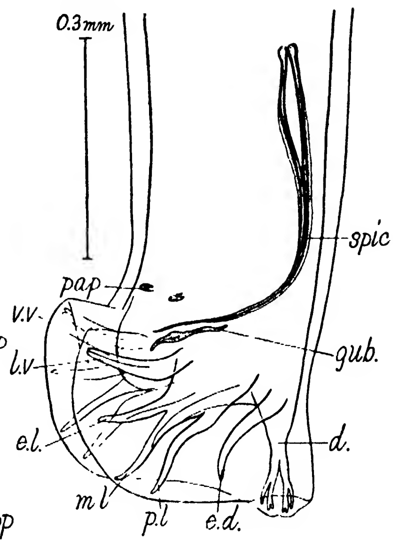
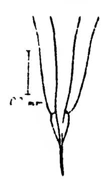
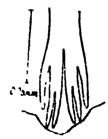
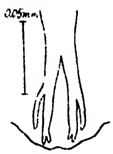


Fig. 18–19. *Raillietostrongylus samoensis* (Lane, 1922).
Fig. 18. Anterior extremity of male; lateral view.
Fig. 19. Posterior extremity of male; lateral view.

The following shows the chief differences between *G. longemucronatus* Molin, 1861, and *Raillietostrongylus samoensis* (Lane, 1922).

	G. longemucronatus	*R. samoensis*
Buccale capsule	approximately infundibular, with rudimentary internal teeth	globular, with well developed internal teeth
Tail of female	0.16–0.2 mm 	0.075–0.1 mm 
Spicules	0.69–0.72 mm, with curved tip	0.4–0.48 mm, with straight tip
Terminal digitations of dorsal ray		

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Yorke, W. and Maplestone, P. A. The nematode parasites of vertebrates, 1926, p. 49 (footnote).

15. *Bunostomum phlebotomum* (Railliet, 1900) Railliet, 1902

An examination of nine males and six females from the small intestine of cattle slaughtered at the Government Veterinary Research Station at Nisigahara gave the following results.

Body 13.5–15.05 × 0.33–0.5 mm in male, 14.56–16.61 × 0.56–0.66 mm in female. Buccal capsule 0.23–0.3 × 0.18–0.26 mm, constantly with one large dorsal, two lateral and two ventral teeth. Esophagus 1.3–1.82 × 0.13–0.28 mm. Nerve ring 0.67–0.78 mm from head end. Cervical papillae and excretory pore at about same level, 0.75–0.91 mm from head end. Spicules 3.9–4.52 mm long, with narrow transversely striated alae. Two long branches of dorsal ray terminate each with three digitations, of which the inner is rudimentary and the middle the largest. Tail in female 0.47–0.56 mm long, tapering. Vulva dividing body length in ratio of 1 : 1.4–2.0. Eggs ellipsoidal, thin-shelled 86–98 × 50–58 μ as fixed in alcohol and measured in water.

As compared with the descriptions by Cameron, Fiebiger, etc. the spicules are longer and the eggs larger in my specimens.

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Metastrongylidae Leiper, 1908

16. *Metastrongylus elongatus* (Duj., 1845) Raill. et Henry, 1911

Numerous mature specimens of both sexes were found in the bronchi of *Sus leucomystax leucomystax* Temm. shot near Kyoto. The filiform body with smooth cuticle, is 15–20 × 0.25–0.28 mm in the male and 28–45 × 0.3–0.48 mm in the female. The trilobed lateral lips are very prominent. The nerve ring lies 0.24–0.3 mm, and the excretory pore 0.32–0.41 mm, from the head end. The esophagus is 0.32–0.46 × 0.06–0.08 mm in the male and 0.54–0.64 × 0.11–0.13 mm in the female.

The slender spicules with transversely striated alae are 4.0–4.6 mm long, and have no true terminal barbs, though their alae may occasionally assume a barb-like appearance at the tip. There is a very small gubernaculum. The

rounded end of the prominent genital cone is curved ventrad. The ventrolateral ray of the bursa is voluminous; the lateroventral ray tapers distally and may be bent dorsad at the end; the externolateral ray has a hammer-shaped terminal enlargement; the mediolateral ray is distinctly trilobed at the end; the posterolateral ray is entirely absent or may be present as a small appendage of the mediolateral ray. The dorsal lobe and the dorsal ray are lacking, but the externodorsal ray may occasionally be found on one side as a slender costiform projection about 45 μ long.

The elongate conical tail of the female is 45–75 μ long and bears behind its middle a pair of small lateral papillae. The trunk of the ovijector is up to about 1.9 mm long. The vagina opens on the dorsal side of the genital protuberance and forms a cloaca, the opening of which is bounded ventrally by the posterior border of the protuberance mentioned above and dorsally by a lip-like elevation. The oval, thick-shelled, embryonated eggs ready for deposition are 48–54 μ long by 34–39 μ broad.

Though the above description does not completely agree with that of Gedoelst, I prefer to assign my specimens to *M. elongatus* (Duj., 1845).

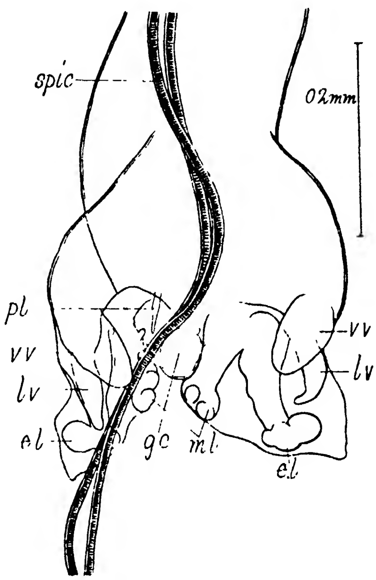

Fig. 20. Posterior extremity of male *Metastrongylus elongatus* (Duj., 1845); ventral view.

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17. *Dictyocaulus viviparus* (Bloch, 1782) Railliet et Henry, 1907

One male and one female adult were found in the lung of *Sika nippon* from the suburb of Kyoto. The male is 26 mm long by 0.3 mm broad and the female 36.5 mm long by 0.43 mm broad. The nerve ring and the excretory pore lie 0.32–0.43 mm and 0.54–0.6 mm respectively from the head end. The esophagus, 0.95–0.98 × 0.12–0.14 mm and slightly attenuated behind the nerve ring, has a membranous bell-shaped appendix projecting into the intestine, a character not mentioned in Richters' description. The so-called cervical glands extending backwards from just behind the excretory pore are very strongly developed.

The plump tail of the male is provided with a continuous ala measuring about 0.15 mm anteroposteriorly. The shorter ventroventral and the longer ventrolateral rays are close together and fused at the base; the externolateral, mediolateral and externodorsal (or posterolateral ?) rays are simple and more

or less swollen at the end; the dorsal ray has three digitations, the middle of which is large and rounded. The dark brown spicules are about 0.19 mm long. The granular accessory piece is 57 μ long.

The pointed tail of the female, 0.36 mm long, has a pair of lateral papillae at about its middle. The vulva lies a little behind the middle of the body. The elliptical, thin-shelled, embryonated eggs are 68–84 × 35–43 μ.

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Richters, E. Über die wechselseitigen Beziehungen der Lungenwurmseuche des Wilders und der Schafe. Zeitschr. f. Infektionskr. parasit. Krankh. u. Hygiene d. Haustiere, Bd. 13, 1913, p. 263-266.

TRICHOSTRONGYLIDAE Leiper, 1912

18. *Trichostrongylus instabilis* (Railliet, 1893) Looss, 1905

This species has been found by Kurisu in 20 hares out of 64 and in 13 rabbits out of 127. The following measurements were made on four females which I have collected from *Lepus brachyurus brachyurus* Temm. at Kuki, Mie Prefecture.

Body 6.16–7.63 × 0.08–0.09 mm; excretory pore 0.11–0.15 mm from head end; esophagus 0.65–0.68 mm long; posterior "cervical gland" reaching to 0.15–0.165 mm from head end; tail straight but occasionally curved at tip, 70–80 μ long; vulva dividing body length in ratio of 4.3–4.88 : 1; eggs ellipsoidal, thin-shelled, 72–78 × 36–45 μ; ova many-segmented when laid.

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Kurisu, Y. Studies on the internal parasites of hares and rabbits in Japan. Jour. Kumamoto Med Soc., Vol. 7, No. 9, 1931, p. 26-27. (Japanese with German abstract.)

19. *Longistriata leporis* n. sp.

DESCRIPTION. A dozen mature specimens from the upper portion of the small intestine of *Lepus brachyurus brachyurus* Temm. The spirally coiled, slender body was blood red when fresh, and measured 5.8–7.0 mm long in the male and 8.0-9.4 mm long in the female, with a maximum breadth of 0.18 mm, The numerous vacuoles contained in the thick cuticle gives the worm a very characteristic appearance; there are fine transverse striations and 13 prominent longitudinal ridges. The expanded cuticle of the head, with the outer diameter of 45–57 μ and constricted off behind, has usually numerous internal transverse striations, but may occasionally have several close transverse rows of minute vacuolar structures said to be characteristic of *Impalaia tuberculata* Mönnig, 1924. The esophagus is 0.33–0.45 mm long. The nerve ring and the excretory pore lie 0.21–0.22 mm and 0.32–0.4 mm respectively from the head end. The cervical papillae may be found at the inconspicuous notches on the more pro-

minent lateral longitudinal ridges at about the level of the excretory pore.

The bursa consists of large symmetrical lateral lobes. The ventroventral and ventrolateral rays are separate except at the base, and directed ventrad. The externolateral is thick; the mediolateral and posterolateral have a common trunk but are widely divergent distally. The externodorsal arises from near the base of the dorsal, which forks in two, each with two digitations. The slender alate spicules are 0.8–0.9 mm long and the gubernaculum is 60–66 μ long.

The female has the posterior end of the body flexed ventrad in the shape of a hook, as in *Longistriata adunca* Chandler, 1932, and a conical tail 60–70 μ long. The vulva lies 75–105 μ in front of the anus. There is no prevulvar cuticular inflation. The thick-walled, forwardly directed ovijector is constricted at the middle.

The eggs are ellipsoidal, thin-shelled and measure 68–78 × 33–39 μ; the ovum is in the four-cell stage when deposited.

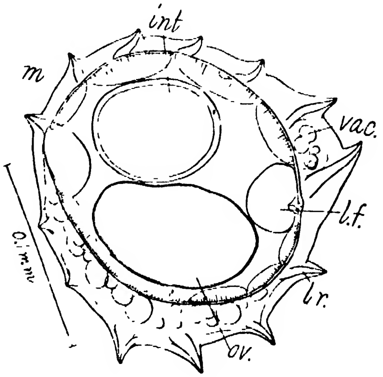

Fig. 21. Transverse section of female *Longistriata leporis* showing longitudinal ridges and vacuoles of cuticle.

Fig. 22 Fig. 23 Fig. 24

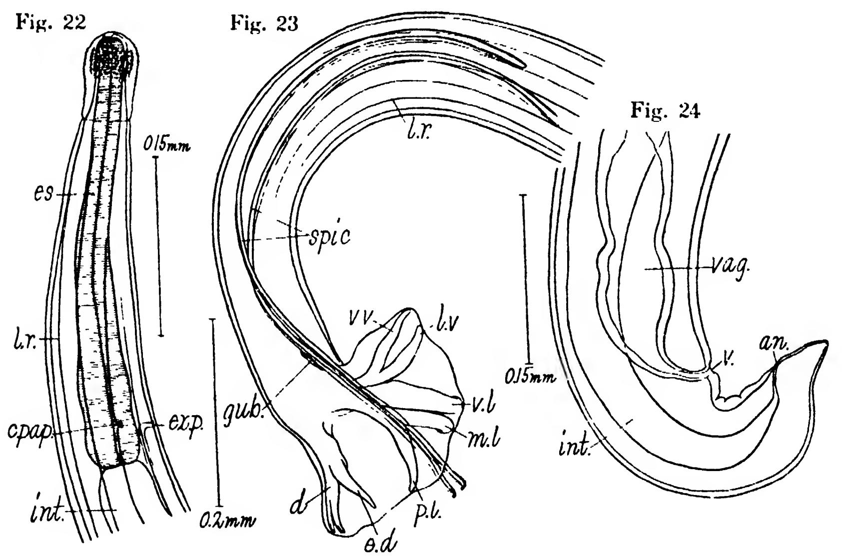

Fig. 22–24. *Longistriata leporis*.
Fig. 22. Anterior extremity of male; lateral view.
Fig. 23. Posterior extremity of male; lateral view.
Fig. 24. Posterior extremity of female; lateral view.

DISCUSSION. This species differs from the closely related *Heligmonella*

streptocerca Baylis, 1928, chiefly in the length of the spicules.

As pointed out by Chandler, *Heligmonella* Mönnig, 1927, is congeneric with *Longistriata*, which was originally proposed by Schulz (1926) as a subgenus of *Viannaia* but elevated by Travassos and Darriba (1929) to generic rank.

Longistriata leporis n. sp.

SPECIFIC DIAGNOSIS. *Longistriata* Schulz, 1926. Body blood red in life, spirally coiled, 5.8–7.0 × 0.15–0.17 mm in male, 8.0–9.4 × 0.16–0.18 mm in female, with 13 prominent longitudinal ridges. Head with cuticular inflation, 45–57 μ in diameter. Esophagus 0.33–0.45 mm long. Spicules 0.8–0.9 mm long. Tail in female conical, 60–70 μ long, flexed ventrad between anus and vulva. Vulva 75–105 μ in front of anus. No prevulvar cuticular inflation. Eggs 68–78 × 33–39 μ.

Habitat. Upper portion of small intestine of *Lepus brachyurus brachyurus* Temm.

Locality and date. Kuki, Mie Prefecture; April 6, 1927.

Type and paratypes in my collection.

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Baylis, H. A. On a collection of nematodes from Nigerian mammals (chiefly rodents). Parasit., Vol. 20, 1928, p. 286–291.

Chandler, A. A. A new species of *Longistriata* (Nematoda) from the cotton rat, *Sigmodon hispidus*, with notes on the division of the Heligmosominae into genera. Jour. Parasit., Vol. 19, No. 1, 1932, p. 25–31.

FILARIIDAE Claus, 1885

20. *Dirofilaria immitis* (Leidy, 1856)

This species occurs frequently in Japanese dogs, especially in stray ones. The body is up to 180 × 0.8 mm in the male and 320 × 1.0 mm in the female. The cuticle is faintly striated transversely. The head bears two lateral and four submedian papillae, the former about as far from the latter as from the mouth opening. The anterior muscular part of the esophagus, 0.56–0.68 mm long, has two slight constrictions, of which the anterior lies 0.16–0.2 mm, and the posterior, at the same level as the nerve ring, 0.3–0.48 mm, from the head end. The posterior glandular part, 0.75–0.87 mm long, has an almost uniform breadth of 0.085–0.1 mm.

The blunt tail of the male is up to 0.11 mm in length. The caudal alae are only recognizable by the presence of very thick papillae, of which four lie one closely behind another in front of the anus, while the postanal ones are similar but smaller; in addition there are three pairs of pointed papillae in a group near the tail end and two further pairs of minute papillae at the tail end. The shorter spicule with a blunt end is 0.2–0.21 mm long and the longer pointed one 0.33–0.34 mm long.

The blunt tail of the female, 0.18–0.2 mm long, has a small terminal notch, at the bottom of which is a papilliform protuberance of the pulp. The vulva lies 3.8 mm from the head end in a specimen 32 cm long. The filiform embryos are up to 0.27 mm long by 5 μ broad.

21. *Setaria equina* (Abildg., 1789) Railliet et Henry, 1911

Four mature females from the body cavity of *Equus caballus* var. *orientalis* Noack slaughtered at the Municipal Stockyard of Kyoto form the basis of the following note.

The body, tapering posteriorly into a loose spiral, is up to 10 cm long by 1.1 mm broad. The cuticle is finely striated longitudinally but not transversely. The small mouth, slightly compressed from side to side, has two lateral lips and two prominent median projections. On the head there are two lateral amphids and four submedian papillae in the same frontal plane, the dorsal pair of the latter being separated from the ventral by a distance of about 0.13 mm and the fellows of a pair about 0.28 mm apart from each other. Just in front of these papillae there is another set of four horn-like submedian processes up to 24 μ long, the dorsal and ventral pairs being 0.15–0.16 mm apart and the fellows of a pair 0.17–0.18 mm from each other. The nerve ring lies 0.24–0.28 mm from the anterior extremity. The anterior part of the esophagus is 0.7–0.75 mm long and the broader posterior glandular part 11.25–11.4 mm long by 0.36 mm broad. The tail, curved dorsad and 0.38–0.4 mm long, bears a pair of conical lateral processes near its terminal rounded button. The vulva lies 0.58–0.7 mm from the head end. The sheathed embryos are 0.25 mm long by 5 μ broad.

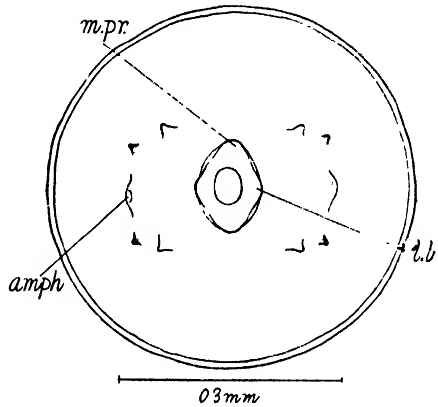

Fig. 25. Head of female *Setaria equina* (Abildg., 1789); end-on view.

SPIRURIDAE Oerley, 1885

22. *Streptopharagus pigmentatus* (v. Linst., 1897)

Sandground determined the specimens collected by the Kelly-Roosevelts Expedition to Indo-China from the small intestine of *Hylobates leucogenys* and *Macaca* sp. as *Streptopharagus pigmentatus* (v. Linstow, 1897). I have also found this species in the small intestine of a Japanese monkey from Nara Prefecture. The following note based on four males and five females will add something to its knowledge and confirm its specific status.

The robust body is 26.45–31.55 × 0.5–0.7 mm in the male and 34–57 × 0.65–1.4 mm in the female.

The finely cross-striated cuticle shows irregular transverse corrugations. In the male it forms in front of the cloaca as well as behind it numerous longitudinal ridges extending to the inner side of the caudal alae. The asymmetrical cuticular inflation of the neck is sharply delimited from the head

cuticle by a distinct constriction. The head with a slightly enlarged pulp is 0.15–0.21 mm broad.

On the head there are four large submedian papillae and two lateral amphids. The dorsoventrally elongate mouth is bounded by three-lobed lateral lips, each lobe bearing a conical tooth on the inner side of its base, and the middle lobe bearing the largest tooth. The median teeth in the dorsal and ventral angles of the hexagonal mouth, as described by Blanc for *Streptopharagus armatus*, are rather rudimentary and may often be wanting.

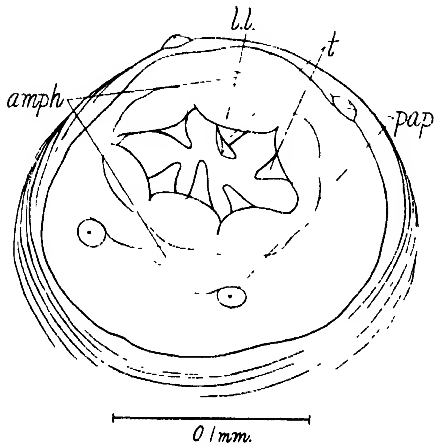

Fig. 26. Head of female *Streptopharagus pigmentatus* (v. Linst., 1897); end-on view.

The cylindrical muscular pharynx, twisted just behind its middle, measures 0.23–0.31 × 0.06–0.088 mm in the male and 0.25–0.37 × 0.075–0.11 mm in the female. The anterior muscular part of the esophagus is 0.3–0.48 mm long in the male and 0.4–0.5 mm in the female, while the broader posterior glandular part is 4.95–6.5 × 0.2–0.25 mm in the male and 5.9–7.5 × 0.26–0.3 mm in the female. One of the cervical papillae lies at the level of the posterior end of the pharynx and the other just behind the nerve ring, which is at about the middle of the anterior muscular part of the esophagus. The conical tail is 0.46–0.53 mm long in the male but a little longer (0.5–0.63 mm) in the female, and has a pair of lateral papillae.

The longer slender spicule is 5.4–5.7 mm long and the shorter 0.65–0.82 mm long. The broad gubernaculum is 60–66 μ long. There are four preanal and one postanal pairs of costiform papillae supporting the caudal alae, the former forming two groups of two each. In addition the posterior border of the cloacal aperture has two papillae as described by Sandground. The complex verrucosity is also present on the ventral surface of the tail.

The not salient vulva lies 9.7 mm from the head end in a female 45.3 mm long, in which the long, comparatively narrow vagina continues into the broader but shorter ovijector at a distance of 1.875 mm behind the vulva. The elliptical, embryonated eggs as fixed in alcohol and measured in water are 36–44 × 18–21 μ; the shell consists of a brownish thin outer and a pale thick inner membrane.

Literature cited

Sandground, J. H. Report on the nematode parasites collected by the Kelley-Roosevelt expedition to Indo-China with descriptions of several new species. Zeitschr. Parasitenk., Bd. 5, Heft 3/4, 1933, p. 570–571.

THELAZIIDAE Railliet, 1916

23. *Thelazia rhodesii* (Desmarest, 1828) Blainv., 1828

Two gravid females were found in the conjunctival sac of a calf slaughtered at the Kyoto Stockyard. In spite of the smooth cuticle,* I would refer them to the present species on account of the close agreement in other essential points mentioned below.

The body, 16.52–17.4 mm long by 0.42–0.56 mm broad, is attenuated at the extremities. The simple mouth has no lips. The head bears an inner circle of 6 papillae, each of which lies at the incision of the reverted outer margin of the buccal capsule, and an outer circle of 8 papillae forming 4 groups of two each. The two so-called amphids (lateral papillae) are found in almost the same transversal plane as the outer circle mentioned above. The ring-shaped buccal capsule is 18 μ deep by 24–26 μ wide at the oral aperture. The cylindrical esophagus is 0.52–0.54 mm long by 54–55 μ broad, and has a posterior valvular appendix projecting into the intestine. The nerve ring lies 0.46–0.48 mm from the head end. The anus is situated about 80 μ from the tail tip, which is blunt and bears on either side a rounded prominence with a minute central pit (probably for nerve-ending), and a small papilla immediately behind it. The vulva lies 0.9-0.91 mm from the head end. The embryos are 170–190 × 3 μ.

Fig. 28

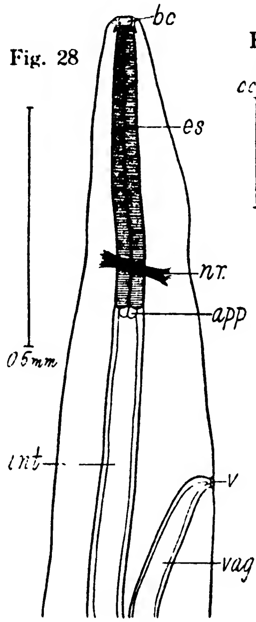

Fig. 27

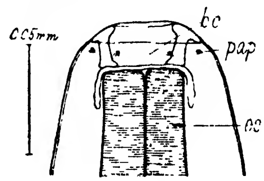

Fig. 27–28. *Thelazia rhodesii* (Desmarest, 1828). Fig. 27. Head of female; lateral view. Fig. 28. Anterior part of female; lateral view.

TRICHURIDAE Railliet, 1915

24. *Trichuris suis* (Schrank, 1788) Smith, 1908

An examination of four male and three female adults from the domestic pig gave the following results.

The body is 36.8–50.68 × 0.53–0.7 mm in the male, 36.8–38.5 × 0.67–0.76 mm in the female. The cuticle is finely striated transversely. At the anterior part of the body, there is a very conspicuous bacillary band. The anterior part of

* Perhaps due to postmortem changes.

the esophagus without cell chain is 0.59–0.88 mm long. The stout spicules with a finely spinose sheath are 1.95–2.24 mm long. The vagina with a thick wall of circular and longitudinal muscle fibers turns a little backward before opening outside. The vulva lies at the anterior part of the posterior third of the body. The dark brown eggs with rounded polar plugs are 56–62 μ long by 25–30 μ broad.

25. *Capillaria* sp.

A few females were found in the urinary bladder of *Nyctereutes procyonoides viverrinus* (Temm.), but since only one entire worm is available for examination, the specific determination is not possible at present.

Body 22.6 × 0.1 mm, with bacillary bands beginning about 1.25 mm from head end and extending backwards for 2.0 mm. Esophagus 6.65 mm long. Vulva 6.7 mm from head end. Eggs barrel-shaped, 64–70 × 28–36 μ; outer shell thin, with uneven surface but no striations in optical section; ova not segmented.

Trichosomoididae Yorke et Maplestone, 1926

26. *Trichosomoides crassicauda* (Bellingham, 1840) Raill., 1895

This species is common in the urinary bladder of *Rattus norvegicus*. The gravid females at my disposal are 11.6–14.1 mm long and up to 0.17 mm broad. The anterior part of the esophagus is 0.13–0.21 mm long and the posterior one with cell chain is about ten times as long. The vulva divides the body length in the ratio of 1 : 5.1–7.3. The thick-shelled, embryonated eggs with polar opercula are 61–70 × 39–47 μ. The male in the uterus are 1.0–1.5 mm long.

The bacillary bands on the dorsal side of the body at the distal part of the uterus, stated by Baylis and Daubney to be apparently absent, are very conspicuous.

Abbreviations used in Figures.

a. ala
amph. amphid
an. anus
app. appendix
b. c. buccal cavity or capsule
c. pap. cervical papillae
d. dorsal ray
d. d. es. gl. duct of dorsal esophageal gland
e. d. externodorsal ray
e. l. externolateral ray
es. esophagus
es. b. esophageal bulb
es. v. esophageal valve
es. p. excretory pore
f. e. filamentous elements
fl. flange
g. c. genital cone
gub. gubernaculum
h. hook
lanc. lancet
l. f. lateral field
l. l. lateral lip
l. r. longitudinal ridge
l. v. lateroventral ray
int. intestine

m. muscle
m. l. mediolateral ray
m. pr. median process
n. r. nerve ring
ov. ovary
pap. papilla
p. l. posterolateral ray
ph. pharynx
rect. rectum
r. gl. rectal gland
r. sp. right spicule
s. m. pr. submedian process
spic. spicule
t. tooth
ut. uterus
v. vulva
vac. vacuole
vag. vagina
vent. ventricle
vest. vestibule
v. v. ventroventral ray

[illegible] Goto

Obituary

Seitaro Goto (1867—1935)

In the twilight of the old Japan, at the close of the Shogunate régime, on August 18, 1867, Seitaro Goto was born as the second son of Moriatu Goto, a samurai of the Tyôsyû clan, who took part in the great task of the Restoration. When he was three years old, his father, a man of marked intelligence and foresight, moved to Ôsaka, then the center of the movement for enlightenment in Japan at dawn of her new era. Through early education the boy became well versed in English, as well as showing an eager interest in flowers and insects. When young Seitaro was fourteen years old he entered upon a life of devotion being baptized at the Tenma Christian Church. Two years later Goto entered Dôsisya College where he came in contact more closely with the current ideas of the West.

Seitaro's mother died when he was young and he was brought up by his eldest sister, Hisa-ko Goto, of whose careful training he often made grateful acknowledgement. His love of nature and his sister's sympathetic advice led him to the study of zoology.

Coming to Tokyo, Goto entered the College of Science of the Tokyo Imperial University, where he studied under Professor K. Mitsukuri. Graduating in 1890, he spent there four more years as a student of the post-graduate course. He was conferred the degree of D.Sc. in 1895. The result of his investigations on ectoparasitic Trematodes of fish was published in the Journal of the College of Science, Tokyo Imperial University, Vol. VIII, Art. 1, 1894. For this brilliant and pioneer work in Japanese parasitology, Goto was awarded in 1913 the prize of the Imperial Academy.

In August 1894 he went to Johns Hopkins University and later to Harvard. During his two years' stay in America he came under the great influence of Dr. K. W. Brooks and Dr. E. L. Mark.

In 1896 he returned to Tokyo where he was appointed professor of zoology at the First Higher School and in 1909 that of the College of Science, Tokyo Imperial University, the chair he occupied until 1928, when he was

made professor emeritus of the university. During this period he was one of editors of 'Annotationes Zoologicae Japonenses' and the 'Journal of the College of Science, Tokyo Imperial University'. Goto was also one of members of the National Research Council of Japan from 1920 until his death. In the later years of his life, he much devoted himself to the edition of the present Journal.

Seitaro Goto became ill on May 18, 1935 with jaundice. An operation of the gall-bladder was carried out at the University Hospital and every medical assistance was rendered. His illness, however, being caused by cancer on the bile duct, he became worse and hopeless and passed away quietly on July 20.

His scientific works sufficed not only to lay the foundation of Japanese parasitology, but also yielded him universal recognition as an authority in that field. He was also the world's authority on the morphology and embryology of Echinoderms and Coelenterates. While his own researches thus contributed to the advancement of the special subjects in zoology, he was a great teacher. Among his pupils there are many zoologists as well as men of medical science. The savant was also one of the founders of the Y. M. C. A. of the Tokyo Imperial University.

Goto was the Japanese delegate to the Third International Zoological Congress in Leyden, 1895; The Congress of the Biological Union in Brussels, 1919; the Extraordinary Congress of the Biological Union in Geneva, 1927; the 10th International Zoological Congress in Budapest, 1927; the 5th General Meeting of the International Science Research Council and the 7th General Meeting of the Biological Union in Brussels, 1931.

The loss of a man from whom much further services were expected, is mourned widely and deeply. The lamented savant is survived by a widow and two daughters, the elder having married his adopted son, Sigeru, and the younger being Mrs. H. Simidu.

Tokusuke Goda

15. An Experimental Study on the Life History and Biology of Trypanosoma conorhini (Donovan), Occurring in the Alimentary Tract of Triatoma rubrofasciata (de Geer) in Formosa

By Kaoru MORISHITA

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With Plates II–IX

CONTENTS

Introduction

Owing to its habit of biting human beings, a reduviid bug, *Triatoma rubrofasciata* (de Geer) (Triatomidae, Hemiptera), has been the object of attention of medical men and the public in Formosa for some time. This insect harbours in fairly high percentage a species of trypanosomid flagellates, informations on which are at present entirely lacking in our country. Morphologically, this flagellate bears a close resemblance to the insectan form of *Trypanosoma cruzi* Chagas, the causative agent of Chagas' disease, which is known to be transmitted by various species of Triatoma and other related bugs in tropical and Central America. These facts aroused my special interest for the flagellate and led me to an investigation of its life history and biology, the results of which are embodied in the present paper. There have been some investigators in Formosa, who attempted to infect certain mammals with the

flagellate, but their endeavours have all failed.

My own investigation of this flagellate species was commenced in 1928 and has been continued with certain interruptions up to the present. Having ascertained the presence of the metacyclic trypanosome forms in the gut contents and feces of Triatoma, my first efforts were directed to effecting infection of mammals with them and the first success was obtained with mice in August, 1928. Several subsequent experiments have been carried out chiefly on mice, which can be most easily inoculated with the gut contents or feces of infected Triatoma. In the course of these experiments, many interesting facts have been brought to light; among others, the specific identity of this trypanosome with *Trypanosoma conorhini* (Donovan) found by Shortt and Swaminath (1928) in Indian materials, and certain primitive features shown by it with regard to the problem of the adaptation of trypanosomes to vertebrate hosts.

Before proceeding further I take this opportunity to pay my respects to Prof. Dr. T. Horiuchi, Director of our Department. I am much indebted to Emeritus Prof. Dr. S. Goto of Tokyo Imperial University for his kindness in reading through the manuscript and making suggestions. I am obliged to Mr. Katagai and Misses Nagao and Kawashima for their conscientious coöperation and especially in taking charge of the breeding and feeding of Triatoma in our laboratory. My thanks are also due to Dr. Kishi and other gentlemen for kindly supplying me with insect materials.

I. Historical Survey of *Trypanosoma conorhini*

In the course of researches on the transmission route of Kala-azar in India, several blood-sucking insects and *Triatoma rubrofasciata* among others occurring in the endemic area naturally attracted the attention of such investigators as Donovan (1909–1913), Patton (1912), Cornwall (1916), Knowles, Napier and Das Gupta (1923), and Shortt, Barraud and Craighead (1926), who attempted to infect this bug with *Leishmania donovani*, the causative agent of that disease, but they obtained only negative results. Donovan (1909), working in Madras, found a flagellate species parasitic in the alimentary tract of *T. rubrofasciata* and published brief notes on its morphology, under the name of *Crithidia conorhini*. It was the first mention of this flagellate, but he looked upon it as a mere parasite of the insect and thought that it had no metacyclic trypanosome form in its life cycle. According to Shortt, Barraud and Swaminath (1926), Awati (1921) found that *Triatoma rubrofasciata* in Assam showed high percentage infection by Crithidia.

Knowles in his book "An Introduction to Medical Protozoology (1828)", p. 166, says that "at the Calcutta School of Tropical Medicine, Dr. R. O. A. Smith has on several occasions found *Triatoma* (*Conorhinus*) *rubrofasciata* infected with a crithidia of its own. On one occasion when the infection of the gut was a heavy one, the gut contents were aspirated into a syringe and injected intra-peritoneally into a white mouse. The animal remained in good health for three months; it was then chloroformed and films from its viscera searched;

no parasites were found". It seems probable that Awati and Smith were dealing with the same flagellate as Donovan's. In order to confirm the findings of Lafont (1912), who has shown that in Mauritius the parasite of *Triatoma rubrofasciata* can be inoculated into certain laboratory animals in whose blood it appears in the form of a Trypanosoma, Shortt and Swaminath (1928) performed the following preliminary experiments. Two white mice and one guinea-pig were injected intraperitoneally with the gut contents of eight *T. rubrofasciata* collected in Assam. On the 10th day thereafter the guinea-pig was found dead and autopsied with negative findings. Three days later, both the mice showed trypanosome infection in the peripheral blood, which lasted for only two days and never recurred. The experimenters thought it probable that the trypanosomes were present at an earlier date than that on which they were detected, as light infections were very difficult to demonstrate by direct examination. As to the source of the Triatoma infection, they expressed the opinion that as the immature forms of this Triatoma are most commonly met with in the nests and boxes of the pigeons kept by many villagers, the possibility that the trypanosome species in question may be that which has been reported from pigeons should be borne in mind. On the other hand they suspected that the bat might be its mammalian host.

Without reference to this finding of Shortt and Swaminath, I performed some infection experiments on animals with Formosan materials, and almost always with positive results; but as far as my researches went, this trypanosome was non-pathogenic at least to mice and rats, but could be grown in certain culture media. A preliminary report on these results was published in December 1928.

The researches of Lafont are most notable. He (1912) noted the fact that in Mauritius and Réunion *Triatoma rubrofasciata* harbours the flagellates in quite high percentage, and he obtained by inoculating mice with its gut contents a typical blood Trypanosoma which first appeared in the blood six hours later and persisted for 1–8 days. He described the insectan and mammalian forms under the name of *Trypanosoma boylei* n. sp., with some observations on their biology. This trypanosome closely resembles the one found in the same species of Triatoma from India and Formosa, and it seems probable that they are identical, although nothing has been said so far on this point. For the present, however, I would reserve my opinion until some obscure points have been cleared up by further researches on Mauritius materials.

We thus see that the literature on the flagellate in question is rather scanty, although the host insect is cosmopolitan and highly parasitised by it. There are many points worth investigating about this parasite and especially its biology, which is the main subject of this paper.

In connection with the historical review of *Trypanosoma conorhini*, mention must be made of the flagellates from the alimentary tracts of other reduviid insects. Since Chagas' finding of *Trypanosoma cruzi* in *Triatoma megista* in Brazil, many *Triatoma* species have been proved to be collateral natural hosts, among others *Rhodnius prolixus*. Rodhain, Bequaert, Pons and Vandenbranden

(1913) described *Crithidia vacuolata* from *Rhinocoris albopilosus* in the Belgian Congo; Kofoid and McCulloch (1916) reported *Trypanosoma triatomae* from *Triatoma protracta* in California; and Tejera (1920) found *Herpetomonas rangeli* from *Rhodnius prolixus* in Venezuela. Of these three flagellate species the first and the last are not well known yet, but the second has been recently proved by Kofoid and Fae Donat (1933) to be the insectan form of *T. cruzi*.

Thus, it is of special interest that some reduviid bugs harbour flagellates which may show various grades of adaptation to vertebrate host, some being much specialized and pathogenic for man, such as *Trypanosoma cruzi*, and some comparatively primitive, parasitic in insects and able to develop only slightly in vertebrate blood. *Trypanosoma conorhini* may be an advanced form as an insectan flagellate but a primitive one as a mammalian parasite, since it is able to live on in mammalian blood but does not go there through the reproductive cycle, as will be seen from the following.

II. Natural Incidence of the Flagellate in Triatoma and its Seasonal Prevalence

Triatoma attacks human beings with preference, and as far as my experience goes, it has been captured only in or near human habitations[1]. In four cases I found its nests in the corner of a stable, in boxes in a storehouse, and under the floor of human dwellings. They occur at random, as a rule, in the adult stage (male or female) or as nymphs of the third to fifth stage, whereas in the nest all developmental stages are found. Although it has so far been found only in Taihoku, Keelung, Tansui, Kagi, Shôka, and Taito, it may possibly occur in the whole island. In Taihoku, whence my materials have mostly come, it occurs almost everywhere, not only in the suburbs but also in the heart of the city.

From April 1928 to December 1932, covering five seasons, the 412 examples of the insect have been captured by the writer in Taihoku. They occur almost all the year around, although no catch has been noted in March, undoubtedly an accidental gap without meaning. Generally, the first appearance is in April and the number keeps on increasing during the summer months from May to August, after which it begins to decrease, as may be seen from Table I.

Table I. Number of *Triatoma rubrofasiata* captured in Taihoku, arranged according to months

month / year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1928				1	4	9	6	9	1	0	23*	0	53
1929	0	0	0	2	3	10	11	12	7	0	0	0	45
1930	0	0	0	2	10	69*	6	7	1	0	0	0	95
1931	0	2	0	1	2	4	10	7	4	1	1	0	32
1932	1	0	0	3	70*	25	12	35	6	1	2	2	187
Total	1	2	0	9	89	117	75	70	19	2	26	2	412

*specimens from nest included.

[1] Mr. Sonan (1922) found it between banana leaves in the neighbourhood of human dwellings in Taihoku.

As to the incidence of infection, out of the 385 insects examined 238 (or 61.8%) contained the parasite. If in this respect we consider the sex and the different stages, where they have been noted, we get the results shown in Table II, from which we see that the infection is most frequent in adult females and least in nymphs.

Table II. Infected Triatoma, according to stage and sex

stage	adult		nymph	total
sex	male	female		
number examined	144	121	58	323
number infected	92	88	27	207
% infection	63.9	72.7	46.6	64.1

Donovan (1909) found the infection rate in India to be nearly 90%, while Lafont (1912) found it for his *Trypanosoma boylei* to be 80% in Mauritius and 50% in Réunion. Compared with Donovan's result, my own percentage figure for total infection is somewhat lower. But we must note that it varies in different years, as shown in Table III, from which we see that the percentage infection ranges betwen 54.3 and 90. It is also different, if the insect lot examined includes many nymphs, which, being less subject to infection, lower the total percentage of infection. The infection rates for adult males and females and for nymphs in different years are separately shown in Table III.

Table III. Infection rate in different years, according to stage and sex

year	stage	sex	number examined.	infected examples	%
1928	adult	male	17	13	76.5
		female	13	13	100
	nymph		14	12	85.7
	total		44	38	*86.4*
1929	adult	male	19	14	73.7
		female	24	22	91.7
	nymph		1	0	0
	total		44	36	*81.4*
1930	adult	male	37	24	64.3
		female	23	12	52.2
	nymph		29	9	31
	total		89	45	*50.6*
1931	adult	male	15	15	100
		female	12	12	100
	nymph		3	0	0
	total		30	27	*90*
1932	adult	male	57	26	45.6
		female	49	29	59.2
	nymph		10	6	60
	total		116	61	*54.3*

We do not see any ground for assuming that the percentage of infection differs according to months, although there are some irregular fluctuations during the year. This point is brought forward in Table IV.

Table IV. Infection rate of Triatoma in different months

	1928		1929		1930		1931		1932		total		
	I	II	I	II	I	II	I	II	I	II	I	II	%
Jan.			0	0	0	0	0	0	1	1	1	1	
Feb.			0	0	0	0	2	1	0	0	2	1	
Mar.			0	0	0	0	0	0	0	0	0	0	
Apr.	1	1	2	0	2	2	1	1	3	1	9	5	55.5
May	4	3	3	3	10	6	2	2	70	38	89	52	58.4
Jun.	8	8	9	7	61	27	4	3	24	17	109	62	56.9
Jul.	6	4	11	11	6	3	10	10	41	20	74	48	67.6
Aug.	7	6	12	9	7	6	6	6	31	12	63	39	61.9
Sept.	1	1	7	6	1	1	3	3	5	2	17	13	76.5
Oct.	0	0	0	0	0	0	1	1	1	0	2	1	
Nov.	17	15	0	0	0	0	1	0	1	1	19	16	84.2
Dec.	0	0	0	0	0	0	0	0	0	0	0	0	
Total	144	38	41	36	90	45	30	27	177	92	385	238	61.8

I = number examined; II = number of infected examples.

It may be safely concluded that the natural incidence of the flagellate in question among Taihoku Triatoma is fairly marked at all seasons of the year. I may add that in other places also the incidence is not markedly different.

III. Materials and Methods of Investigation

The materials of Triatoma used in this study were obtained from human dwellings in or out of nests, or bred in the laboratory. The insects were kept separately in wide-mouthed glass tubes with gauze caps and containing strips of thick paper to afford resting places for the inmates. They were generally fed on normal rabbits (Pl. II, fig. a).

The flagellates were obtained from the gut contents of naturally or experimentally infected Triatoma. Experimental infection was easily effected by allowing laboratory-born insects to feed on mice previously inoculated with the gut contents of infected Triatoma and containing typical trypanosomes in the peripheral blood; and the Triatoma thus infected can be kept alive longer than those captured in nature.

The gut flagellates were studied chiefly on fixed smears of infected gut contents, prepared by diluting the latter with normal saline solution, thoroughly stirring them and centrifuging for three minutes at 1,000 revolutions per minute. The supernatant fluid containing the flagellates was transferred with a pipette into another tube and again centrifuged for five minutes at 2,500 revolutions per minute. After pouring off the supernatant fluid, smears of the sediment

were made on slides and exposed to osmium vapour for 20–25 seconds or dried in the air or desiccator, then placed in methyl alcohol for three minutes, and stained with Giemsa mixture. Better results were obtained when the stain was diluted with slightly alkaline medium.

The staining of the gut flagellates is not an easy matter, especially when much food debris is present. Those from the mid-gut, however, are often well stained when the contents are scanty and uniformly digested. For wet films, the usual method of fixing in Schaudinn's solution and staining with iron haematoxylin was followed, but it did not always give good results. Films of the mammalian blood were made from the tail of infected mice, fixation taking place in methyl alcohol, and staining by the Giemsa method modified by diluting with slightly alkaline medium; the results were very beautiful. Wet preparations of the blood were also made in the usual manner.

For sections of the gut, hot Schaudinn's or Carnoy's fluid was used as fixative. As a rule, it is very difficult to obtain good preparations for observing the behaviour of the flagellates in the gut, principally because of the rich contents; the section method is not good for general use especially for nectomonad forms.

For counting the trypanosomes in the peripheral blood, it was found impracticable to carry out the more exact methods proposed by several authors because of the small size of the mice, the only animals used in my experiments, so that the rather primitive method of spreading out on the slide two blood drops from the tail of a mouse into a circle 1.5 cm in diameter, staining and counting the parasites in 100 (sometimes 50) optic fields was adopted, a method useful for a general orientation as to the intensity of infection and the numerical variation of the parasites at different stages of infection.

Particulars of the methods employed will be dealt with at the respective places.

IV. Life History of *Trypanosoma conorhini*

A. DEVELOPMENT IN THE INSECT HOST

As the development of this trypanosome in the insect host proceeds only in the alimentary tract, it is thought useful to give some information on it. The following quotation from the 'Text-book of Medical Entomology' by Patton and Cragg is given for this purpose. "The alimentary canal shows the usual divisions and is remarkable for the low insertion of the Malpighian tubes. The pharynx is elongate, corresponding with the shape of the head, and boat-shaped, the anterior end being much narrower than the posterior. The esophagus emerges from the posterior end of the pharynx as an extremely delicate tube, and passes through the neck and thorax. At its termination the thickness of the wall of the gut is greatly increased, and the wall itself thrown into a number of thick folds, forming a proventriculus. The mid-gut commences as a saccular swelling of considerable size, equal to about one-fourth the total

length of the alimentary canal. Posterior to the saccular portion of the gut the lumen is very much constricted. The tube (hind-gut) is convoluted and situated mainly in the posterior part of the abdomen. The rectum is very sharply marked off from the rest of the gut by its creamy white colour. It is pear-shaped, with the broad end directed forwards. The four Malpighian tubes enter the gut just anterior to the commencement of the rectum". To this I want to add a few remarks. The rectum is dark coloured for at least one week after the ingestion of mammalian blood, but creamy coloured after one week more. For the length of about 1–2 mm just in front of the rectum, the hind-gut is markedly swollen and filled with dark contents, a condition almost always met with when the gut contents are rich. With regard to the development and distribution of the flagellates in the hind-gut, I will treat the anterior tubular and the posterior saccular parts of it separately.

The flagellates occur only behind the mid-gut, and are represented by crithidial, leishmanian and metacyclic trypanosome forms, with mingling of several transitional forms.

a. Descriptions of Various Forms Found in the Insect Body

1. Crithidial Form

(Pl. IV, figs. 19–33; Pl. V, figs. 34–69; Pl. VIII, figs. 153–158)

The fundamental form found in the insect body has usually a crithidial structure. Under favourable gut condition the flagellates increase especially in this form; it is very active in movement, of various shapes and the size varies from 8 μ to 43 μ long, with all intermediate ones; a condition probably brought about by repeated unequal division, as generally thought. With regard to its size the crithidial form falls into three groups, large, medium and small, although the structure is fundamentally similar. The small group (Pl. V, figs. 60–69) are those which are 8–16 μ long, the medium (Pl. V, figs. 34–59) 16–30 μ long and the large (Pl. IV, figs. 19–33) 31–43 μ long. The shape is also variable, in asmuch as there are broad as well as very slender individuals, and short as well as very long ones. Some have long band-like bodies of almost uniform breadth throughout (Pl. IV, fig. 22). The posterior extremity is, as a rule, pointed, but often blunt; in the former case the body tapers behind very gradually, but in the latter the posterior end is more or less truncate. Towards the anterior end, the body generally tapers very gradually and is finally transformed into a cytoplasmic sheath of the axoneme. I have observed a peculiar form in which the body is abruptly constricted in front of the nucleus and continued forward in the form of a slender band (Pl. IV, fig. 33).

With Giemsa stain the nucleus is, as a rule, round, but often oval or long oval; when oval its long axis is generally parallel to the body axis but sometimes at right angles or oblique to it. In wet preparations, however, it is always round (Pl. VIII, figs. 153–158), with a diameter of 3.75 μ and occupies

almost the entire breadth of the body or 2/3–1/2 of it. With Giemsa stain the nuclear meshwork is granular and stains densely whereas with haematoxylin it shows only a single large endosome at its centre, as is generally in Trypanosoma. It lies, as a rule, in the middle part of the body or somewhat further backward, but in broad forms, whether large or small, it is situated markedly backward. The parabasal body is very prominent and in Giemsa preparations, lies generally just in front of the nucleus or at its side, attached or close to it, whereas in haematoxylin slides, it is always detached from the nucleus (Pl. VIII, figs. 153–158). It is interesting to note that among individuals, which were transferred from the mammalian blood into Triatoma within 24 hours, the position of the parabasal body with respect to the nucleus varies, sometimes lying just behind it or at various distances further backward, probably showing transitional conditions to the crithidial form (Pl. IV, figs. 17–18). The parabasal body stains with Giemsa intensely red or reddish-violet and is generally rod-shaped or oval, but rarely round, whereas with haematoxylin it is always of comparatively long rectangular shape.

The axoneme commences a little in front of the parabasal body. With Giemsa stain it is not easy to detect the blepharoplast which may be present at the posterior end of the axoneme. In wet preparations, however, the proximal part of the axoneme expands into a weakly staining fan-shaped structure, with which the parabasal body is often connected by a peculiar bridge (Pl. VIII, fig. 155). Kofoid and McCulloch (1916) observed in *Trypanosoma triatomae* in some instances a fan-shaped suspensory body or parabasal rhizoplast running from the blepharoplast towards the parabasal body; it may be identical or at least functionally analogous to the structure above mentioned. The axoneme runs forward in the cytoplasma, which tapers into long narrow sheath around the axoneme. The free part of the flagellum is subject to marked variation in length, being 2–14.5 μ long in small forms, 3–14 μ in medium forms and 3–15 μ in large forms. Roughly speaking, the small form has in many cases rather long free flagellum.

The undulating membrane is well developed in large crithidial forms with 3–4 turns, while in small forms it is inconspicuous or may be absent. No special cell inclusion is visible in crithidial forms.

Division. It is strange that in spite of the great numbers of crithidial forms in the gut of Triatoma, division is not frequently met with, at least in smears. Lafont (1912) also found a similar condition in *Trypanosoma boylei* and remarks, "Fait remarquable: dans toutes ces formes que nous venons de décrire, on n'observe presque pas de divisions". I have, however, been able to actually observe some dividing individuals (Pl. V, figs. 53–55 & 68). As far as my observations go, division seems to be equal, although often unequal, and the process appears to be somewhat different in different cases. It may commence with the elongation of the parabasal body and the development of a new axoneme, after which the parabasal body divides, nuclear division coming last. It is interesting to note that the newly produced short axoneme projects freely outside the still undivided body (Pl. IV, fig. 32). The division of the

body proceeds from fore backward; in some cases, however, it may commence with the division of the parabasal body, and one daughter parabasal body may carry the old axoneme, while in other this develops later (Pl. V, fig. 68). Occasionally in such cases, nuclear division appears to take place, and a longitudinal line is often seen extending along the long axis of the body, and may lead to the production of a non-flagellated daughter individual; and further division of such non-flagellated individuals without production of the axoneme, may result in the production of so-called spindle-shaped bodies (Pl. VII, figs. 113, 114). It is probable that division takes place more actively in small crithidial forms than in large ones, their aggregation and division rosettes are more frequently met with in the former.

2. Transitional Forms

Pl. VI, figs. 70–97; Pl. VIII, figs. 159–164)

These are in the process of transforming themselves from crithidial to leishmanian forms. The body is of irregular shape, foreshortened and rounded posteriorly and with the nucleus and kinetoplast situated notably behind the middle of the body, although arranged as in Crithidia. Though referable rather to the crithidial category, the extreme forms look very similar to leishmanian forms (Pl. VI, figs. 78, 83, 90, 96; Pl. VIII, figs. 160, 161).

The transitional forms appear to be separately derived from each group of crithidial forms, so that they fall like them into three size groups: small, medium and large. The body is 9–14 μ long and the greatest breadth lies, as a rule, at the level of the nucleus, which is situated markedly backward. The shape is very variable, sometimes almost round with a long protoplasmic process containing the axoneme, the so-called tadpole form (Pl. VI, figs. 70, 77, 79–81, 85, 94–96).

The position of the kinetoplast with respect to the nucleus is variable; the former lying as a rule in front of or antero-lateral to the latter, but sometimes laterally or far in front; in many cases it is not attached to the nucleus. In wet preparations the structures of the nucleus and parabasal body and the relation of the latter to the axoneme are nearly the same as in crithidial forms (Pl. VIII, figs. 159–164). The elongated part of the body is conspicuous, but the free portion of the flagellum is only 4–7 μ long. The undulating membrane is inconspicuous or not developed.

Division has often been observed in transitional forms, and proceeds similarly as in crithidial forms; in some cases the production of a new axoneme is followed by the division of the parabasal body (Pl. VI, fig. 79), while in some cases the order is reversed (Pl, VIII, fig. 163). The transitional forms move very actively by the vibration of the slender anterior body.

3. Pyriform Individuals

(Pl. VII, figs. 98–106)

They are short and broad with pointed anterior and rounded posterior ends. The flagellum can be detected only with difficulty, possibly owing to its bad affinity for the Giemsa stain; when present, it is only 3–9 μ long. The nucleus lies at the middle of the body or somewhat further backward. The relative position of the nucleus and kinetoplast is of crithidial type, but occasionally the kinetoplast may lie posterior to the nucleus. The body is almost constantly 10–15.5 μ long. Division has not been met with in this form.

4. Spindle-shaped Individuals

(Pl. VII, figs. 107–118; Pl. IX, fig. 173)

These are of unusuall occurrence, being seen occasionally crowded together or in aggregations. The body is only 8–11 μ long, slender and spindle-shaped, but the greatest breadth may sometimes be nearer to one pole, which is generally rounded. The nucleus may be central or somewhat nearer to the rounded end. In spite of much effort, the flagellum could not be detected except in very rare cases. The parabasal body is conspicuous. It may be that these fusiform individuals undergo active division, since several individuals are often found attached to one another as if they were derived from a single mother individual (Pl. VII, figs. 116, 117). As previously suggested, these individuals may result from a rapid division of the crithidial form. Their fate could not be ascertained, but they may be transformed into the small crithidial form or may undergo degeneration, since the parabasal body is sometimes absent. As a rule, they are motionless, but occasionally a slow motion can be detected and rarely two may be seen in motion, enclosed in a common thin membranous capsule (Pl. VII, fig. 118).

5. Leishmania Form

(Pl. VII, figs. 133–149; Pl. VIII, figs. 165–167)

This form is very variable in size, being 5–9 μ $\times$ 4–8 μ, probably according to the size of the transitional form from which it has been derived respectively. The body is as a rule irregularly round, although some are of perfectly round. The nucleus is very large and genarally eccentric in position or may even lie near the body margin. The parabasal body is also conspicuous and lies near the nucleus, attached to it or somewhat apart or occasionally far removed from it. The flagellum is present in many of the individuals, the free part being 7–19 μ long (Pl. VII, fig. 133; Pl. VIII, figs. 165, 166), and in them, the axoneme runs as a rule the shortest course from the kinetoplast and is projected outside the body.

It is noteworthy that in some individuals the axoneme runs for about two

thirds of the periphery of the body before leaving it (Pl. VII, fig. 134), reminding us of the metacyclic trypanosome form, from which they may have been derived, as indicated by various transitional forms between the two (Pl. VII, figs. 122, 123).

In wet preparations the nucleus and the parabasal body show the same structure as in the forms already described (Pl. VIII, figs. 165–167). The frequent presence of two nuclei and two parabasal bodies may indicate the occurrence of division (Pl. VII, figs. 145–147). On the other hand, there are examples in which the parabasal body is inconspicuous or entirely lacking, probably owing to degeneration (Pl. VII, figs. 148, 149). The significance of the occurrence of leishmania form in this species will be discussed later on.

6. Trypanosome Form

(Pl. VII, figs. 119–132; Pl. IX, fig. 172)

This so-called metacyclic trypanosome form occurs in the insect gut in various shapes, but the nucleus and the parabasal body are placed relative to each other as in Trypanosoma, i. e. the former is anterior to the latter. The body is either slender and sickle-shaped and 9–13 μ long (Pl. VII, figs. 119–123), or short and rounded and 4–8 μ long (Pl. VII, figs. 124–132). The nucleus is generally elongated oval, but often kidney-shaped, quite a peculiarity of this form (Pl. VII, figs. 122–127, 132). In slender examples it is posterior to the body centre, but in broad ones it is subcentral and is often attached to the concave side of the body. The parabasal body is conspicuous and lies at or near the posterior extremity of the body. The axoneme, arising from near the parabasal body, runs along the convex side of the body and projects beyond it as a free flagellum, as a rule only 15 μ long. In broad examples, it often runs along almost the entire periphery of the body (Pl. VII, figs. 124–127, 130–132). Roughly speaking, short broad examples are more numerous than slender ones. Division has been observed, though not frequently. This form is easily recognisable by its very active and peculiar movement.

b. Chronological Observations on the Development of the Flagellates in the Insect Body

Since the natural infection route is still unknown, laboratory born insects were allowed to bite mice which contained the trypanosomes in the peripheral blood, and the subsequent development in the insect gut was followed chronologically. Insects whose infection was thought perhaps successful were fed on rabbit blood only in some cases. Intracellular and haptomonad stages could not be observed, although their possible occurrence can not be denied. The following descriptions refer entirely to free-living forms in the gut lumen.

The gut contents of the infected insects were examined at certain intervals in the fresh state as well as in smear preparations and the condition of the development and distribution of the flagellates were noted. The observa-

tions lasted from August to November, 1930, and were supplemented by those made in August 1931 and May 1933. The high temperature prevailing during these periods was thought favourable for the development of the flagellates.

Table V. Temperature during the observations

year	month	average temperature (C°) maximum	average temperature (C°) minimum
1930	August	32.16	29.36
	September	30.6	27.13
	October	26.79	23.79
	November	23.7	19.76
1931	July	31.82	28.03
	August	32.37	28.06
1933	May	28.71	25.65

1. The Development and Distribution of the Flagellates in the Alimentary Tract of the Infected Insect at Various Hours after Feeding

24 hours after

The mid-gut is entirely filled with fresh-coloured blood and the flagellates have not advanced to other parts of the alimentary tract. The ingested trypanosomes are almost all transformed into the large crithidial form with broad body often showing the undulating membrane, densely staining with Giemsa, and 18.5–34.5 μ in length. The individuals are still few, but it may be noted that there are some examples still retaining the trypanosomid arrangement of the nucleus and parabasal body (Pl. IV, figs. 17, 18), the latter lying just behind the former or at a fair distance from it. These are perhaps in the process of transforming themselves from the mammalian trypanosome to the crithidial form and are called by Minchin and Thomson, 'crithidiomorphic type' of trypanosomes. Kofoid and McCulloch (1916) observed in the stomach of *Triatoma protracta* which was removed from a rat's nest 4 days before, trypanosomes of a smaller, narrower, and often straighter type, perhaps indicating that the flagellate can remain in the trypanosome form fairly long. In my material, however, the transformation of the trypanosome into the crithidial form seems to be completed in a short time, so that, as just mentioned, almost all individuals are of crithidial type only 24 hours after feeding. Some few pyriform and spindle-shaped forms may be present, but no other form can be detected.

3 days after

The flagellates are still confined to the mid-gut, whose contents are still of blood colour. In place of the large, now more or less diminished crithidial form, the medium and the small ones have increased in number, and division and aggregation are often observable. It is notable that the spindle-shaped

individuals occur in fairly large numbers, often attached to each other as if they had just undergone division. Pyriforms and transitional forms are also found, though very few. Generally speaking, they are more numerous than at any time previous.

5 days after

The flagellates have reached the anterior part of the hind-gut, but the posterior saccular portion is still free from them; they are found in great numbers due to reproduction. In the mid-gut the medium-sized crithidials predominate, with mixing of some few large and small ones. The spindle-shaped individuals are also present, and it is notable that not a few leishmania form occurs also. In the anterior part of the hind-gut the long slender and medium-sized crithidials as well as transitional and leishmania forms are observable, and it is of especial interest that the metacyclic trypanosome form is occasionally found.

7 days after

The flagellates have spread to the posterior saccular portion of the hind-gut and occasionally even the rectum, but they are still few in these portions. In the mid-gut, however, they have much increased in number, with predominance of rather regularly formed medium-sized crithidials. The small crithidials are also present in fair numbers, but the large ones are fewer, and divisions are often met with. The spindle-shaped individuals are not so numerous as on the third day; the transitional forms are few. What is difficult to understand is the occasional presence of small flagellates, probably of spindle-shaped ones, wrapped in couples by a thin membranous capsule.

In the anterior part of the hind-gut the medium-sized crithidials predominate over the large ones and the transitional forms, which are few. In the posterior saccular part of the hind-gut the parasites are still few in number, with a predominance of medium-sized crithidials and small minglings of the transitional and leishmania forms. The rectum is still free from the parasites, or very few spindle-shaped individuals may be present infrequently.

10 days after

The mid-gut shows a moderate infection. All the three forms of crithidials occur in large numbers, with aggregations of medium-sized ones. Pyriforms and transitionals are few, and the leishmania-form occurs not rarely. The anterior part of the hind-gut is parasitized by a fairly large number of the flagellates, which are almost entirely medium-sized crithidials (17–24.5 μ long) of slender form, only few being transitionals. In the posterior saccular portion of the hind-gut the flagellates are fairly numerous and represented by medium-sized crithidials with broad body; transitional forms are few. In the rectum principally large and medium-sized crithidials occur.

14 days after

The parasites are numerous in all portions of the gut and the irregular forms have increased in number. In the mid-gut large and medium-sized crithidials predominate, but the transitional and leishmania forms are not few. In the anterior part of the hind-gut the medium-sized crithidials are somewhat more numerous than the large ones; as a rule, they are slender in shape. There are also small crithidials, spindle-shaped individuals and transitional and leishmania forms. Few metacyclic trypanosome forms are present. In the posterior saccular portion of the hind-gut the infection is sometimes slight, but sometimes very heavy. Almost all the examples are large or medium-sized slender crithidials; the small ones are few. Pyriforms, transitionals and leishmanians as well as metacyclic trypanosome forms are also present. In the rectum the parasites are numerous, with a predominance of small crithidials and mingling of large crithidials, transitional and leishmania forms; the metacyclic trypanosome forms appear here for the first time, but are still very few.

20 days after

In the mid-gut the flagellates occur in enormous numbers composed principally of large and medium-sized slender crithidials, with small minglings of pyriforms, transitionals, spindle-shaped individuals and leishmanians. The anterior part of the hind-gut is heavily infected mostly by medium-sized and small crithidials, but some few transitionals and metacyclic trypanosome forms are also found. The posterior saccular portion contains fairly large numbers

Table VI. Chronological findings on the development of the flagellates and their location in the insect body

Days after infection	Portion of gut	Crithidial form			Transitional form		Leishmania form	Spindle-shape	Metacyclic tryp. form	crithidiomorphic tryp.
		large	medium	small	tadpole	other form				
1	MG	+						±		±
	HG									
	R									
3	MG	±	+	+		±		++		
	HG									
	R									
5	MG	±	+	±	±		±	±		
	HG A	+	+		+	+	±		±	
	HG P									
	R									

7	MG	+	++	++		±		+	
	HG A	+	++			+			
	HG P	+	+						
	R							±	
10	MG	++	++	++	±		±	+	
	HG A	+	++	+	+	+			
	HG P	+	+	+	±	±			
	R	+	+		±				
14	MG	+++	+++		+	+	+		
	HG A	++	++	+	+	+	±	±	+
	HG P	++	++	+		±	+		+
	R	+		++		±	±		±
20	MG	++	++	+		+	+	+	
	HG A		+++	+++		+			±
	HG P	++	+++	+++			±	+	+
	R		+	+++					

A = anterior; HG = hind-gut; MG = mid-gut; P = posterior; R = rectum.

of medium-sized and small crithidials, with some few spindle-shaped individuals and leishmania forms. Some typical round metacyclic trypanosome forms are seen. The rectum is of dark cream colour and moderately infected, small crithidials predominating.

25 days after

In insects which did not receive the second feeding, the flagellates in the gut decreased in number, but were numerous in those fed a second time. It is notable that the metacyclic trypanosome forms are now markedly more numerous in all parts of the gut. The occurrence of the other forms in the gut is irregular and no rule can be set down as to their distribution, which depends on various factors. Later also the occurrence of each form in the several parts of the gut is not subject to any rule; each one can invade any or all portions of the gut.

2. Summary of the Observations

After the ingestion by Triatoma, the trypanosomes of the mammalian blood are transformed almost entirely in the gut into crithidials in 24 hours. During

the first day of infection, the flagellates are confined to the mid-gut, but reach the anterior part of the hind-gut at the latest 5 days after. After two days more they invade the posterior saccular part of the hind-gut and the rectum, although as yet in small numbers. Henceforward various forms of the flagellate can occur in each part of the gut. During the first period of infection, however, there is some regularity in their appearance. At the beginning of infection when the gut is still full, the typical crithidial form predominates and the spindle-shaped individuals are found only occasionally. This condition is not altered by the second feeding, whenever it may take place. Further on, the crithidial form is enormously increased, but various irregular forms also increase gradually and finally appears the leishmania form. As far as my observations go, the metacyclic trypanosome form is observable as early as 5 days after the first infection, although as yet very few in number, and invades the rectum after 9 days more at the latest. Its further increase seems to depend on the condition of the host. On the tenth day after the first infection there is no general rule as regards production of different forms and their distribution in the gut; it is perhaps influenced by several factors, so that the peculiar developmental course in accordance with the position of the infected organs and the time elapsed since the infection do not appear to be followed, although it is the case in certain other trypanosomes; a point to be discussed later on. As a matter of fact, we find as a rule on dissecting insects captured in nature, that the rectum contains enormous numbers of metacyclic trypanosome forms in some cases, while in other cases it contains various other forms. This may indicate that the development of this trypanosome in the insect is subject to irregularity, at least as the infection proceeds further.

c. First Appearance of the Flagellates in the Feces of Infected Insects

After ingestion of infected mouse blood, the insects were allowed to bite normal rabbit, as frequently as possible, and microscopical examination was made at each defecation. As far as the writer's observations go, the first appearance of the flagellates in the feces was 13 days after the first feeding, in many cases, however, 20 days or more. These differences may be due to the frequency of defecation, low frequency entailing lateness of the first appearance. After the establishment of the infection, however, and especially when heavy, the flagellates come out at each defecation, although their forms vary considerably, apparently owing to the different forms present in the rectum.

d. Distribution of the Flagellates in the Insect Body

The flagellates occur only in the mid-gut and backwards. Exhaustive search in the proventriculus, esophagus, salivary gland and body cavity gave negative results, and only once were the Malpighian tubes found to contain the flagellates. This exceptional occurrence has in my opinion no biological

significance, as the developmental cycle can be completed only in the gut. In *Trypanosoma cruzi*, which presents many points of resemblances to the present species, there are some uncertainties as to the distribution of the flagellates in the insect body. Chagas (1909) has described flagellates of the trypanosome type from the coelomic fluid of the bugs and also mentions their occurrence in smears of the salivary gland; but no other observer has been able to demonstrate their occurrence in any form in the body cavity or salivary gland, although Torres reports that he has been able to effect infection by allowing the bugs to bite the experimental animals. Recently Dias (1930) has reported the occurrence in the Malpighian tubes of adult *Triatoma megista* of some developmental forms of *Trypanosoma cruzi*, which probably represent a phase in the active multiplication of the trypanosome. I believe, however, that it was an exceptional case and that in *T. cruzi* the invasion of organs other than the gut seems to be very rare and not at all at a stage in the normal developmental cycle. Both *T. conorhini* and *T. cruzi* are substantially gut parasites.

The distribution of *T. conorhini* in the insect gut varies at different periods and also depends on the food supply. As stated in another chapter, in the early days of infection, the flagellates, chiefly of crithidial forms, are limited to the mid-gut and enter the hind-gut at the latest on the fifth day after the first feeding, the rectum being invaded on the tenth day. Afterwards they occur throughout the gut and rectum. In the early stages of infection, when only the anterior parts of the gut are parasitized, the prevailing forms are crithidials, but later on other developmental forms appear in all parts of the gut. In other words, there is no organ-specificity for each form, such as is the case e. g. in *T. lewisi*, in which, according to Minchin and Thomson, each developmental form occurs in a particular organ. That in insects captured in nature various forms of the parasite occur simultaneously, as in them infection is generally in an advanced state, seems to strengthen the above statement.

The leishmania form can be produced not only in the hind-gut but also in the mid-gut; and something similar is true for several transitional forms. The metacyclic trypanosome form, though more frequently found in the hind-gut and rectum, also occurs in the mid-gut. Hence we may conclude that the development of this flagellate can proceed without special relation to certain tissues or certain cells of the insect gut, and that it can complete its life cycle in any part of the gut, except the rectum where the parasites are probably passively transported from the adjoining part of the hind-gut.

Examination of the gut in sections has not revealed the presence of haptomonad or intracellular forms, although the latter has been reported once in *T. cruzi*.

e. Probable Life Cycle in the Insect Body

On the life cycle of trypanosomid flagellates in the insect body, opinions differ even for the same genus. Although it is certain that the life cycle is

generally complicated and difficult to analyse, this divergence of opinions is often due to incomplete or insufficient observations, which may easily result in confusions or even erroneous conclusions. Even for the same species contradictory statements have been made by different observers.

Although as generally known, the classification of the Trypanosomidae is

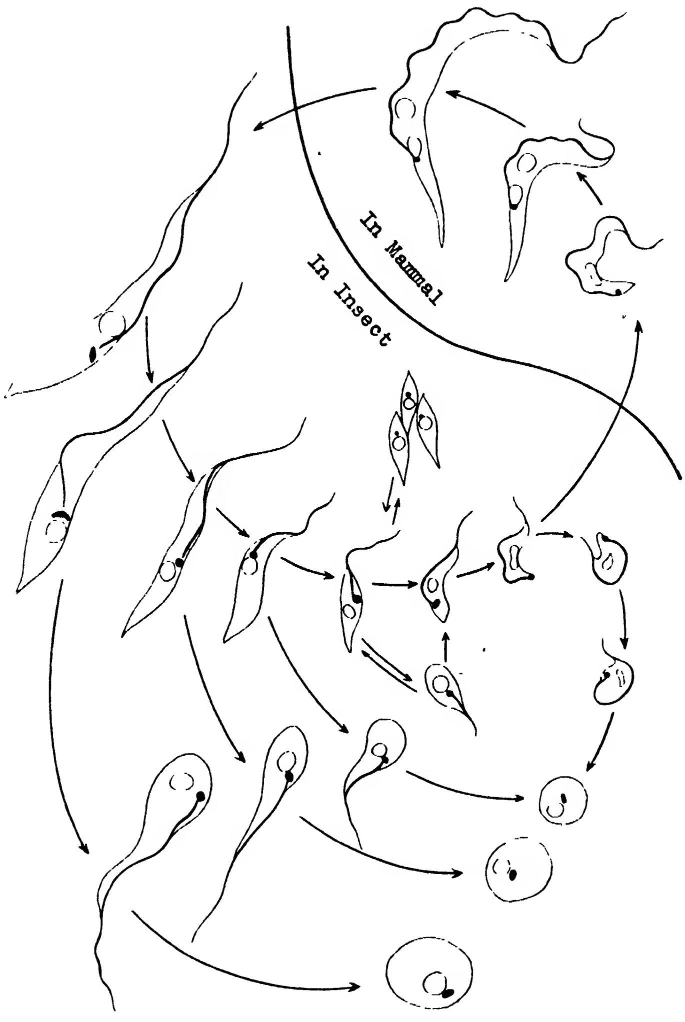


Fig. 1. Diagram showing the probable life cycle of *T. conorhini* in Triatoma and mammal.

based on the highest stage of the developmental cycle, the generic names, *Leishmania*, *Leptomonas*, *Herpetomonas* and *Trypanosoma*, are not always derived from this stage. In *Trypanosoma* the highest stage is the trypanosome form and at the same time it is the endproduct of development. In *Herpetomonas*

all the forms found in *Trypanosoma* occur, but they are thought to have different biological significance, and especially the metacyclic trypanosome form seems to have different meanings in the two genera. Similarly, the leishmania form present in various genera has different meaning in each. In other words, the same form recurring in various groups has not the same value in the life cycle, and therefore the final product of the life cycle in the insect body may differ accordingly as it is destined to enter the vertebrate host or another insect of the same species. In *Trypanosoma* the metacyclic trypanosome form is destined for the vertebrate host, whereas in *Herpetomonas* it stays in the insect body. In this respect *Trypanosoma* species may show higher adaptation to parasitic life than those of *Herpetomonas*. And there may be others intermediate between them in this respect and capable of adapting themselves to altered environment, an important point to be borne in mind by students of the life history of flagellates in the insect body. It is highly probable that future experiments will show that many *Herpetomonas* species should be referred to *Trypanosoma*, and that the acquisition of a more advanced adaptation to parasitic life is not excluded.

Trypanosoma conorhini is a primitive form of the genus and seems to retain many characters peculiar to insect flagellates. In forms highly evolved as vertebrate parasites, such as *T. gambiense*, *T. brucei* etc., the endproduct of the life cycle in the insect host is the infective, metacyclic trypanosome form, whereas in those which parasitise only insects the final stage of the life cycle is that of the so-called resistant form. In the trypanosome before us, the significance of the appearance of the leishmania form as well as the production of the metacyclic trypanosome form in its life cycle should not be overlooked, and I am of opinion that its development may proceed in two different directions, viz. to the production of leishmania form (leishmania cycle) on the one hand and to the production of metacyclic trypanosome form (trypanosome cycle) on the other and that the former may play a more important rôle in its life history.

Since the initial form in the insect body as it occurs in nature, is still unknown, I must start with the crithidial form, which is the one readily obtainable by allowing the insects to bite infected mice.

The typical trypanosome form in the mammalian blood is transformed into the crithidial form in the insect gut, generally within 24 hours. These crithidials are large and multiply by quickly repeated equal or unequal division, producing smaller and smaller daughter crithidials, so that crithidials of various sizes are generally met with in the insect gut at each examination. Several irregular forms with rounded or shortened bodies are also produced, apparently under the influence of environmental conditions. I call them transitional forms under the assumption that they are on the way to be transformed into the rounded leishmania form, though the production of typical crithidials from them is also probable. According to the size of the crithidials from which they have been produced, the transitionals are of various sizes. The transitional forms multiply by division, and the body becomes shorter and shorter and

finally rounded. Some of these rounded examples may bear a long slender tail enclosing the flagellum, looking like a tadpole, but the tail is finally withdrawn and the rounding of the body is complete. The free axoneme often remains after the rounding of the body is complete, but soon disappears. The round or leishmania form contains a nucleus and a kinetoplast, rarely with a trace of the axoneme arising from the latter. This form varies considerably in size, corresponding to the transitional form from which it has been derived.

There are various opinions as to the significance of leishmania in the life cycle. Some regard it as being on the way being transformed from the active to the resistant form, and there have been reports of the occurrence of cysts in the insect body, by which infection is spread among insects. But there are also cases where the cysts can not be proved to occur, and furthermore, as Wenyon (1926) has pointed out, the thick envelope which has been figured as cyst wall by numerous observers is probably artefact due to the accumulation of extraneous materials around the leishmania form during the drying of the film; in still other cases, the structures described as cysts were probably yeasts or even spores of microsporidia. In case the true cysts are not produced, then the question naturally arises, how the infection spreads among insects. It appears to me that two possibilities should be borne in mind in considering this question, viz. either the cyst wall is easy to overlook, or infection can be effected by the leishmania form itself as well as by other forms. Whichever may be the case, the form which effects infection among insects, is of great importance and its production should be the final object in the life cycle so far as the insectan flagellates are concerned.

So far as my own observations go, encysted forms nor any others which can be regarded as in any way resistant do not occur; but the natural infection rate of Triatoma by this parasite is quite high, as mentioned in a previous chapter. It is obviously improbable that this high infection is due to vertebrate hosts, because these, even if present, are not of common occurrence. As a matter of fact, naturally infected vertebrate hosts have not been found yet. Furthermore, there is the possibility that, since this trypanosome appears primitive as a vertebrate parasite, it can infect vertebrates only with difficulty. Why then is the infection rate of insects so high? I am of opinion that owing to its primitiveness as vertebrate parasite, this trypanosome still retains the general characters of insect flagellates and is able to infect new insect hosts directly by any of the forms it assumes, as in true insect flagellates generally. If this be granted, it may be assumed with some probability that the leishmania form is endowed with enough power of resistance to play an important rôle in effecting new infections, and the production of the leishmania form in this trypanosome may be of significance, although this suggestion lacks as yet a factual basis. On the other hand, it may also be assumed that infection among insects can come about from the ingestion of any form other than leishmania, and such an ingestion may easily happen in nature, since the insects are known to fondly lick the freshly excreted feces containing various forms of the flagel-

late. I am therefore of opinion that the spread of this trypanosome among insects takes place through the intermediation of the leishmania form supplemented sometimes by other forms. There are sometimes seen degenerating rounded forms. This fact seems to indicate that in this flagellate, the leishmania form is comparatively short-lived and disintegrates under unfavourable environment conditions. At any rate, the cycle composed of the crithidial form of various sizes and the irregular forms derived from them, and their transformation into the leishmania, constitute in my opinion an important part in the life cycle of this flagellate which in many points retains the characters of insect parasites.

Another course of the development of this flagellate leads perhaps to the formation of metacyclic trypanosome forms, as in more highly specialised trypanosomes. In this case the crithidials produce by division smaller crithidials, which can be transformed into trypanosome forms by change in the position of the nucleus and parabasal body. Similar results may be produced also by the division of pyriforms, which are probably derived from medium-sized and small crithidials. The trypanosomes produced in this way can develop into typical mammalian forms when introduced into the mammalian blood by any means whatsoever. It is, however, highly probable that some of those which remain in the insect gut can be transformed into the leishmania form, since rounded or oval forms with trypanasomid arrangement of nucleus and parabasal body and free flagellum are sometimes met with. Wenyon has observed similar forms in *Herpetomonas muscarum* and many others have reported from the insect gut the occurrence of rounded trypanosome forms similar to those observed by me. It seems that these flagellates, though producing trypanosome forms, still retain characters of insect flagellates. Thus, in the trypanosome species before us the life history appears to consist of two different cycles mentioned above. But, as it is not as yet highly specialised as mammalian parasite, the two developmental cycles may run into each other at a later stage and terminate with the leishmania form.

As to the significance of the non-motile spindle-shaped form produced in fairly large numbers by vigorous division, I must reserve my opinion, but I think they probably become typical crithidials later on.

It is uncertain under what conditions one or the other of the two cycles prevails, but the leishmania form is almost always present as infection advances, though comparatively rare when the food supply is good. It seems that the leishmania form occurs more commonly and is produced more frequently than the metacyclic trypanosome form, which appears in enormous numbers in some cases but not at all or only in small numbers in others.

B. DEVELOPMENT IN THE MAMMALIAN HOST.

As far as I know, the natural mammalian host, if at all existent, has not been brought to light, but the experimentally inoculated flagellates can develop in mice and rats into typical blood trypanosome, as already mentioned. All

the observations on the morphology, development and biology of this trypanosome in the mammalian blood, are therefore based on the materials obtained by experimental infections in the laboratory.

a. MORPHOLOGY OF TYPICAL MAMMALIAN BLOOD TRYPANOSOMES

(Pl. III, figs. 1-13; Pl. IV, figs. 14-16; Pl. VIII, figs. 150-152; Pl. IX, figs. 168, 169)

In fresh blood on the slide, *Trypanosoma conorhini* appears as a long, thread-like, colourless, actively moving body amid the corpuscles, which it throws about here and there by its motion. Its form and size, and the relative and absolute dimensions of each body part vary considerably according to age and are subject to progressive change in the course of infection, attaining maximum length usually on the third day after infection. Its structure also undergoes gradual change for about five days after inoculation, when they settle down to a steady condition. On the next day after inoculation, the examples are very small and some of them are similar in structure to the metacyclic trypanosome form in the insect body, or only slightly different from it (Pl. III, figs. 1-3). The body may be very fragile, not easy to bring out in thick films with the Giemsa stain, and not well stained even in thin films. After the second day, however, they appear normal in both thick and thin smears.

Shape. The body, when fully developed, is large and extraordinarily elongated, owing especially to the long thread-like posterior part. On the first day (within 24 hours) of infection, however, the characteristic shape has not been assumed yet, and the body is small and short, widest at the centre, whence it tapers rather gradually towards both extremities.. The part lying behind the kinetoplast[1] is not yet elongated but more or less conical and sharply pointed. On the second day (within 48 hours), most individuals have become fairly long and slender, with a long tail narrowed directly behind the kinetoplast and with a pointed or somewhat blunt end (Pl. III, figs. 6, 7); the slender tail is occasionally twisted, apparently an unnatural condition. The middle third of the body proper lying in front of the nucleus is of almost uniform breadth, but the anterior part tapers gradually while the posterior is elongated as already mentioned. The undulating membrane usually runs along the convex side of the body. The body shape just described appears to be the normal one in the adult trypanosome, and is not subject to marked further changes in the course of infection, although it may become subsequently more or less slender, and length of the posterior part and the free flagellum relatively to that of the whole body may undergo a fairly prominent change, mainly on account of the elongation of the anterior part of the body and the shortening of the free flagellum. For the dimensions see Table VII.

Cytoplasm. The cytoplasm does not usually contain chromidial or other

[1] I use the term "kinetoplast" to designate the parabasal body and blepharoplast taken together.

bodies. With Giemsa the cytoplasma of the posterior body portion stains weakly, while the middle, with the exception of the undulating membrane, stains deeply in full-grown examples. In young examples less than 24 hours old, the whole body is lightly stained; the difference being probably due to different development of the myoneme in the middle body portion. With iron-haematoxylin also, the middle portion stains somewhat deeper than the other parts.

It is worth noticing that in some rare cases, that peculiar body lying sometimes in the anterior part of the body and sometimes behind the kinetoplast and staining with Giemsa just like the parabasal body was present (Pl. IV, figs. 14, 15). It was rod-shaped or oval, about as large as the parabasal body, and constricted at the middle, suggesting division. Its nature is problematical, but it is probably not derived from the parabasal body, because it may occur very far from the latter.

Myoneme. This undergoes progressive development with the growth of the Trypanosoma, being most distinct in the middle part of the body, where it occasionally shows in full-grown examples as dotted lines with Giemsa. A similar structure has been illustrated by Shortt and Swaminath (1928) in their

Table VII. Average dimensions of ten specimens of *Trypanosoma conorhini* in μ on each day (mouse No. 136)

Day	I	II	III	IV	VI	VIII	X
Total length	28.33	46.8	53.3	53.05	52.65	50.05	50.03
Length of body proper	19.93	32.5	39.7	40.35	44.6	42.75	42.8
From posterior end of body to kinetoplast	7.07	14.5	16.56	14.81	12.7	11.38	11.4
From kinetoplast to posterior margin of nucleus	2.48	4.15	4.06	4.55	3.9	3.85	3.7
From posterior end of body to posterior margin of nucleus	9.42	18.7	20.1	19.01	16.6	14.5	15.05
Dimensions of nucleus	2.8 ×1.7	2.6 ×2.0	2.6 ×2.1	2.2 ×1.9	2.3 ×1.8	2.5 ×1.6	2.2 ×1.6
From anterior margin of nucleus to anterior end of body	7.8	12.45	18.7	20.05	25.0	25.4	25.2
Length of free flagellum	8.4	14.3	13.6	12.7	9.05	7.30	7.5
Breadth of body on level of nucleus	1.94	2.13	2.36	2.07	2.07	1.86	1.88

preliminary report on the same trypanosome.

Peculiar structure in front of the parabasal body. In contact with the front surface of the parabasal body, there is a peculiar structure stained almost uniformly reddish or pinkish with Giemsa and nearly as large as the nucleus (Pl. III, figs. 5–7, 9–13). It is well defined, oval and pot-shaped, with somewhat narrower, truncated posterior pole. The axoneme, arising from the blepharoplast, runs anteriad along its outer margin in intimate contact with it and the posterior terminal portion of the axoneme apparently fused with it. In degenerated forms, however, such a fusion is not present, and a complete

structure composed of the parabasal body, blepharoplast and axoneme arranged as usual, remains after the pot-like structure has disappeared (Pl. IX, figs. 170, 171). However, there may exist a certain intimate relation between the axoneme and this structure, since in a few instances, the two remained connected after the degeneration of the body has begun. The pot-like structure probably has something to do with the movement of the flagellum.

The structure in question is in various stages of develoment 24 hours after infection. In some examples it is totally absent, while in others it is represented by a halo, or lightly stained area (Pl. III, fig. 4); its development appears to be subject to a good deal of variation in time, examples of 24 hours sometimes showing it well defined (Pl. III, fig. 5), while it is sometimes not well developed in examples of 72 hours (Pl. III, fig. 8). In adults, however, it is almost always well defined. The fact that the completion of this structure is accompanied by a more active movement of the trypanosome, leads us again to the conjecture that it has something to do with movement. In this connection, it is worth noting that when the trypanosome is affected by degeneration, the structure in question rapidly disappears. In iron-haematoxylin preparations, the structure is only represented by an indistinctly delimited halo, in which the blepharoplast appears to be suspended (Pl. VIII, figs. 150–152).

Nucleus. The spherical or elliptical nucleus occupies the greatest part of the body breadth in its natural position, has a well-defined membrane and a structure generally seen in the Trypanosoma-group, and contains a large endosome in wet preparations (Pl. VIII, figs. 150–152) or many irregular granules in Giemsa preparations.

The position of the nucleus varies according to the age of the individual. In examples of 24 hours, it lies nearly at the centre of the body or very slightly further forward, whereas in those of over 48 hours its position changes on account of the elongation in different ways of the anterior and posterior parts of the body. Thus, in individuals of 72 hours, the posterior part is somewhat more elongated than the anterior, and the nucleus comes to lie somewhat anteriorly to the centre of the body. In almost all individuals of 96 hours, however, it is somewhat behind the centre, owing to the further elongation of the anterior part, while the posterior part remains almost steady, constant in length. After the fifth day of infection, the anterior part continues to increase more or less in length, whereas the posterior part is rather shortened, so that the nucleus comes to lie at last near the anterior end of the posterior one third of the body, where it stays thenceforth. There is no real migration of the nucleus[1].

It is of special interest that among examples of 24 hours, there are not rarely those with uniform nuclei generally found in metacyclic trypanosome form in the insect gut (Pl. III, figs. 1, 2). Even after 72 hours, this immature form of the nucleus occurs sometimes (Pl. III, fig. 8); hence it seems probable that some of the inoculated metacyclic trypanosome form individuals do not

[1] The proportions of the several body parts at different ages are given in a later chapter.

develop into typical ones in the mammalian blood, but retain their primitive form for a fairly long time, after which they may or may not undergo degeneration.

Parabasal body. The parabasal body lies not far from the nucleus, from which it is farthest on the fourth day of infection, but approaches nearer to it with the subsequent shortening of the body. The parabasal body is very large and prominent, granular or rod-shaped, and stains deeply. As a rule, it lies near one side of the body and only occasionally in the interior of the body far from the outside.

Blepharoplast. This is not visible in Giemsa preparations and the axoneme apparently arises directly from the parabasal body. In wet preparations, however, there is present a little in front of the parabasal body a small granule, from which the axoneme is seen to take its origin (Pl. VIII, fig. 152). Further observations are, however, necessary to decide whether or not it is a true blepharoplast, though topographically it seems probable. Something similar can also be seen in degenerated forms (Pl. IX, fig. 170). At any rate, it appears probable, as Wenyon and others think, that the parabasal body, blepharoplast and axoneme are related in some way or other, since they remain in connection even when the body is affected by degeneration or lysis (Pl. IX, figs. 170, 171). I have not succeeded in bringing to view the rhizoplast connecting the kinetopast and the trophonucleus.

Axoneme. The axoneme which stains well with alkalinized Giemsa, runs forward along the outer border of the undulating membrane, and finally enters the free flagellum.

Flagellum. The flagellum formed of the well defined axoneme and the more or less obscure cytoplasmic sheath, reaches its maximum length 48 hours after inoculation, when it is almost as long as the tail, or flagellum : body proper =ca. 1 : 3-3.2. In full-grown examples of 72 hours after infection, the flagellum has become shorter, the ratio to body length being then 1 : 6 or 1 : 7.

Undulating membrane. 24 hours after infection the undulating membrane is still not well developed and generally shows only two or three large undulations. After 48 hours, however, it becomes very prominent, with 4–6 undulations, and subsequently 6–8 small ones.

As may be seen from the above account the metacyclic trypanosomes introduced into the mammalian blood do not attain full size or show typical structure 24 hours after. 48 hours after inoculation they already show typical structure and the tail and flagellum are conspicuous. The nucleus lies at the centre of the body in the early stage, but after the fourth day, it shifts its position backward, owing to the marked elongation of the anterior part and the shortening of the posterior part of the body. The definitive form of this trypanosome in the mammalian blood has now been attained. The trypanosome illustrated by Shortt and Swaminath from India from a blood smear 13 days after inoculation, may be a full-grown one.

b. Growth and Variation in Body Length of *Trypanosoma conorhini*

According to Lafont (1912) working in Mauritius, *T. boylei* from the blood of mice, showed a progressive increase of body length in the course of infection, being longest 130 hours after inoculation with the gut contents of Triatoma. I have also made similar observations in the course of my study, as briefly referred to in a preceding chapter.

It is perhaps a well known fact that in trypanosomes well-established in the vertebrate blood, smaller forms appear in later stages of infection, chiefly owing to rapid multiplication. In the present species, however, the mammalian blood form progressively becomes larger in the course of infection, in contrast to examples which occur earlier, say 24 hours after infection, and are very small, whether in fresh or in smears. This perhaps suggests that active division does not take place in the present species. Indeed division has never been found in the mammalian blood in any case or at any period of infection. Lafont in his experiments arrived at a similar conclusion.

1. General Observation on Growth According to Daily Average Length

Increase in size has been determined by making daily measurements of 50 or 100 specimens from a very heavy infection in a mouse (No. 136). Examples from the first day, i. e., 24 hours after inoculation, are still very small, with the total length[1] of 21 μ minimum, 38.5 μ maximum, and 28.1 μ average. (Lafont got 11–12 μ from examples of 30 hours.) On the second day, although there still remain small forms 27 μ long, not a few examples are more than 40 μ long, with the maximum of 54 μ, and the average of 45.7 μ. On the third day all are over 40 μ long, with the maximum of 61 μ, and the average of 53.7 μ; growth has now reached its height, individually and on the average. On the fourth day there is not marked change in the body length, the minimum being 38 μ, maximum 62 μ, and the average 53 μ; length of 40 μ-55 μ occurring in large numbers. After the fifth day, however, the body length decreases somewhat, the average being 49 μ on the sixth day, 50 μ on the eighth day, 47 μ on the ninth day, 46 μ on the tenth day and 49 μ on the eleventh day. In other words, the trypanosome before us grows rapidly in 72 hours after being introduced into the mammalian blood, reaches the height of its growth on the third and fourth days, after which it undergoes a slight shortening, which is clearly due to the notable shortening of the free flagellum, as will be shown later on.

If the body proper alone is considered, it is seen that the body length increases after the fourth day and that the maximum is reached on the sixth day, as shown in Table VIII.

[1] Including the free flagellum.

Table VIII. Total body length on each day in μ (mouse No. 136)

Days	I	II	III	IV	VI	VIII	IX	X	XI
Number of specimens measured	100	,,	,,	,,	,,	,,	50	,,	,,
Maximum	38.5	54.0	61.0	62.0	60.0	58.0	53.5	53.0	53.0
Minimum	21.0	27.0	41.0	38.0	41.5	44.5	41.0	41.0	40.0
Difference between maximum and minimum	17.5	27.0	20.0	24.0	18.5	13.5	12.5	12.0	13.0
Average	28.1	45.7	53.7	53.0	49.1	50.4	47.0	46.2	49.1

The result may differ according to individuality of the host, the degree of infection etc., so that in another case (mouse No. 122), in which 10 specimens were measured, the body length reached the average maximum on the sixth day of infection, and underwent slight shortening after seventh day.

2. Individual Variation of Body Length on Each Day.

The individual variation of body length on each day is not so marked as in *Trypanosoma lewisi*, and the difference between the maximum and minimum lengths diminishes with the progress of infection and almost becomes nil at a late stage. I have made the following observations, in which measurements of 50 or 100 specimens were carried out on each day.

First day. Minimum length 21 μ; maximum 38.5 μ; modal length 35.1–30 μ; next numerous 21–25 μ; individuals of over 35.1 μ very rare.

Second day. Minimum length 27 μ; maximum 54 μ; modal 45.1–50 μ; next numerous 40.1–45 μ; under 40 μ and over 50 μ comparatively rare.

Third day. General increase in length; minimum 41 μ; maximum 61 μ; modal 50.1–55 μ; next numerous 55.1–60 μ; under 50 μ comparatively rare.

Fourth day. Minimum 38 μ; maximum 62 μ; modal 50.1–55 μ; next numerous 55.1–60 μ.

Sixth day. Minimum 41 μ; maximum 60 μ; modal 45.1–50 μ; next numerous 50.1–55 μ; over 55.1 μ not many.

Eighth day. Minimum 41 μ; maximum 58 μ; modal same as on sixth day and remaining constant until the eleventh day. Individuals 50.1–55 μ long are nearly as numerous as those of modal length. Individuals under 45 μ and over 55.1 μ in length very rare.

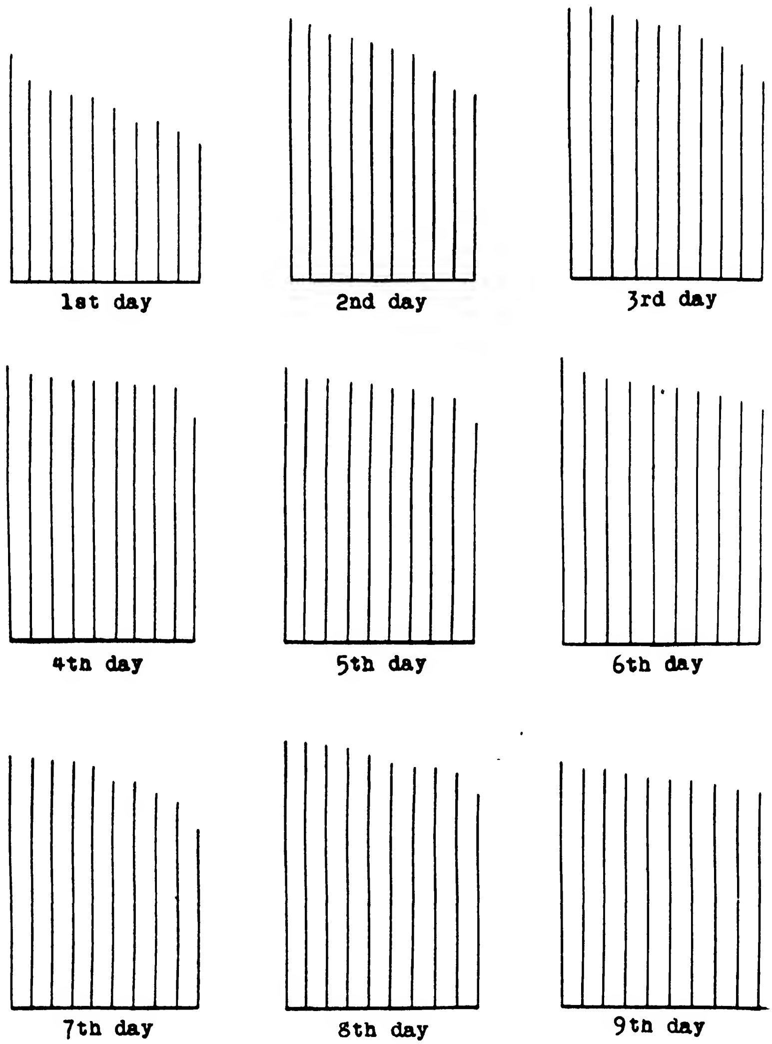
Ninth day. Minimum 41 μ; maximum 53.5 μ; modal same as on last day; next numerous 40.1–45 μ in length.

Tenth day. Minimum 41 μ; maximum 53 μ; modal same as on last day; next numerous 40.1–45 μ.

Eleventh day. Minimum 40 μ; maximum 50 μ; modal same as before; next numerous 50.1–55 μ. Individuals under 45 μ in length comparatively rare.

As stated above, the variation in body length on each day is not so marked as in *Trypanosoma lewisi*, in which, according to Taliaferro (1923), it is so great during the period of reproduction that the maximal length may be more than three times as great as the minimum, whereas in the non-reproduction

or adult the length varies only between 28.6 μ and 31.6 μ. In the trypanosome before us the daily variation in body length is not so great, the maximum being always less than twice as great as the minimum. On each day almost



Text-fig. 2. Lengths of ten trypanosomes taken at random on each day in the course of infection in mouse (No. 122) arranged in order of their lengths μ. Note the minor variations throughout the course of infection.

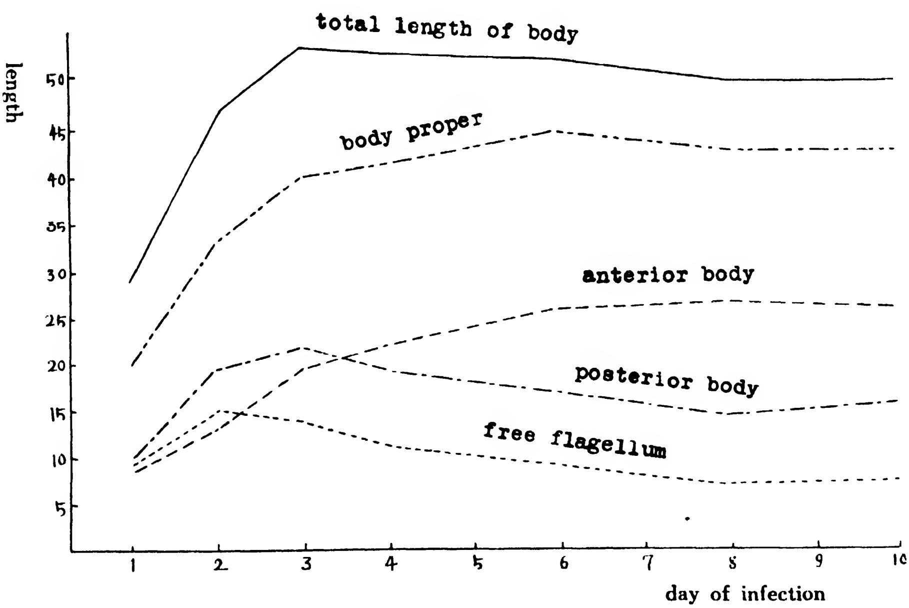
all or at least about half of the individuals keep within the modal value. After the sixth day of infection, the variation in body length becomes still less, the limits being 40 μ and 60 μ. These results seem to be due to diminished reproductive activity, as will be discussed further on.

Table IX. Percentage of different body lengths on each day

Length in μ \ Day	I	II	III	IV	VI	VIII	IX	X	XI
21 -25	24								
25.1-30	55	1							
30.1-35	18	1							
35.1-40	3	9		1					2
40.1-45		34	2	6	16	5	30	40	2
45.1-50		45	12	14	53	46	58	54	68
50.1-55		10	49	46	25	44	12	6	28
55.1-60			36	29	6	5			
60.1-65			1	4					
Number of specimens measured	100						50		

3. Change of Proportion of Different Parts of the Body

Changes in the proportion of the different parts of the body are correlated



Text-fig. 3. Changes in length of different parts of the body in the course of infection in mouse (No. 136); average of ten specimens for each day.

with growth. In mouse No. 136, the body proper appears to have attained the limit of growth on the third day of infection, after which only a slight increase in length may take place. However, marked changes occur in the parts anterior and posterior to the nucleus in such a way that the posterior portion somewhat exceeds the anterior in length until the third day of infection, but becomes shorter after the fourth day and continues shortening, so that after the sixth day the anterior portion may be 10μ longer than the posterior, entirely on account of the shortening of the latter and the great elongation of the former.

The free flagellum attains its greatest absolute length on the second day and then progressively becomes shorter until the tenth day, when it is about half as long as on the second day. This shortening of the flagellum may be the main cause of the shortening of the total body after the fourth day of infection. These changes in the lengths of the different parts of the body are shown in Text-figure 3.

c. Division

It is very strange that examination of numerous blood smears from infected mice, has not resulted in any finding of division nor of any stage which can be looked upon as preliminary or subsequent to it, e. g. elongation or division of the parabasal body. It is generally said that in actively dividing *T. lewisi*, *T. gambiense* and others, many short, broad examples about to divide are seen. In the species before us, however, the body becomes rather longer and narrower as it grows. Especially noteworthy in this connection is the presence, in one case only, of two bodies very similar to the nucleus in structure as well as in size in the middle part of the body, one near to and the other somewhat far removed from the ordinary nucleus (Pl. IV, Fig. 16). It is not easy to ascertain whether they were derived from the ordinary nucleus, although this seems probable. If they were derived from the nucleus, they must be regarded not as a normal but as an abnormal or accidental occurrence, as the parabasal body does not show inclination to division, as it generally does before nuclear division. In fact like Lafont in his *T. boylei*, I have been unable to prove the occurrence of division in this trypanosome.

On the other hand, the numerical fluctuation of the trypanosomes in the peripheral blood is not marked, and this fact seems to indicate that division, if it occurs at all, takes place only at rare intervals. Furthermore, it is noteworthy that inoculation from mouse to mouse does not easily succeed, the second inoculation being followed by infrequent appearance of the trypanosomes in the blood and the third always giving negative results. This point will be further discussed in relation to the immunity of the host.

d. Distribution of the Trypanosomes in the Mammalian Body

In order to know in what organs of the host the trypanosomes are distribu-

ted, smears were prepared from the different organs of successfully infected mice, as proved by examination of the peripheral blood, precaution being taken not to allow the exuding blood to mix. The results are shown in Table X.

Table X. Distribution of the trypanosomes in mice

		66	74	91	68	99
No. of mouse		66	74	91	68	99
Days after inoculation when killed		17	9	9	10	10
Organs	peripheral blood vessel	+	+	+	+	+
	lung	−	+	+	+	+
	heart	+*	+†	+*	+*	−†
	liver	−	+	+	+	+
	kidney	+	−	+	−	−
	spleen	−		−		−
	brain			−		−
Intensity of infection		slight	slight	moderate	heavy	heavy

* blood from ventricles. † blood from tissue.

The blood-infected organs were the lung, heart, liver and kidney; the spleen and brain were free of the parasites, although chance occurrence in them must not be excluded. When the peripheral blood was slightly infected, the organs also showed comparatively few parasites, although a constant finding was not always obtained for each organ even when the peripheral infection was fairly heavy. It is probable that the distribution of this trypanosome in the mammalian body is influenced not by the course of infection, but by its grade, although even this may not act uniformly. At any rate, this trypanosome seems to be able to enter the blood vessels of any organ without any predilection for certain of them.

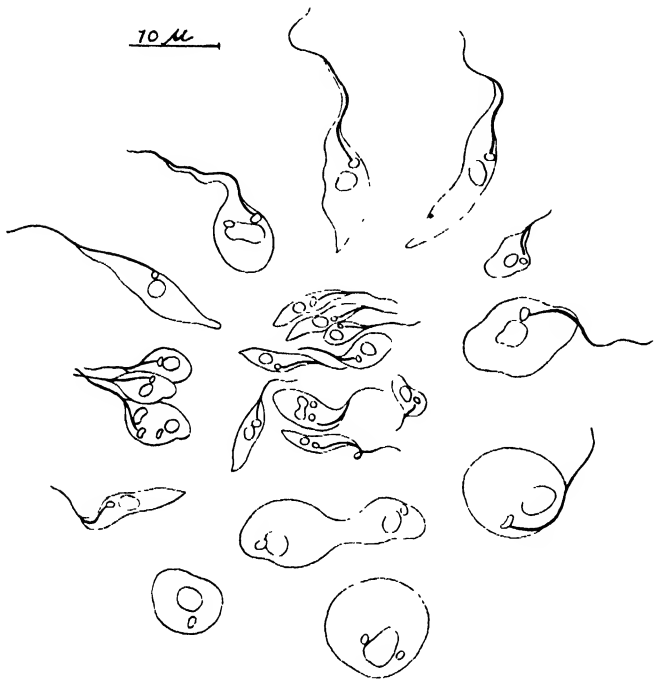
Examination of sections of various organs gave absolutely negative results, unlike *Trypanosoma cruzi*, which multiplies in the muscles of various organs. In the species before us, the tissues are not invaded, that is to say, there is no histotaxis. This point can also be seen from the shortness of the incubation period mentioned in another chapter, which can not be the case if the trypanosomes were to multiply in the tissues. I have not made any estimation of the relative number of the parasites in the blood of different organs.

C. DEVELOPMENT IN CULTURE

Culture of this trypanosome has not been performed systematically, so that much must be reserved for future investigation. Only some preliminary ex-

periments have been made and they prove that this trypanosome is culturable in certain media.

The media used for culture experiments are N-N-N-media (with rabbit or horse blood), normal nutritive agar with rabbit blood, Torres media and Kligler's semisolid media, and the flagellates were isolated with sterilised capillary tubes from the insect gut; incubation was done at 25°C. In one tube of normal agar medium with rabbit blood, the flagellates actively developed in the condensation water, and after its exhaustion, on the slant of the medium, for 36 days in the same tube. The subcultures from this tube, however, have not succeeded well; in the first subculture multiplication went on for three days, but all disappeared after seven days more; the second subculture gave entirely negative results.



Text-fig. 4. Various culture forms of the flagellates from the alimentary tract of Triatoma.

In the culture, almost all the forms present in the alimentary tract of Triatoma appeared; generally the small crithidial form predominated over the large one and even dividing leishmania examples were found. The transitionals became numerous in a late stage of the culture, when the pyriforms also appeared. Small leishmanians were not rare and apparently encysted ones were often met with, although it was very difficult to ascertain their nature. The presence or absence of metacyclic trypanosome form has not been determined. All attempts at culture from the mammalian heart blood resulted in failure. Further experiments are needed to clear up the behaviour and development of this flagelate in culture.

V. Biology of *Trypanosoma conorhini* in the Mammalian Host

The behaviour of this species in the mammalian host is not dealt with in any previous reports. On this point, Lafont's paper on *Trypanosoma boylei* appeared to me of special interest, though its specific identity is still ques-

tionable. He made some observations on its infection course and growth in mice, and the infection by it of laboratory-born Triatoma fed on mice, etc. For the reason already mentioned, my materials for the biology of this parasite have been exclusively drawn from mice, which can be infected most easily by various methods but especially by intraperitoneal injection with the gut contents of infected bugs.

A. TRANSMISSION EXPERIMENTS IN MAMMALS

As the metacyclic trypanosome form produced in this species in the insect gut is discharged with the feces, infection in nature is probably effected by the feces containing the infective form, instead of through insect bite. I have, however, thought it advisable to vary my experiments as much as possible, because nothing on this line has been done.

a. Transmission Under Experimental Conditions

1. By Intraperitoneal Injection

A certain dose of saline emulsion of the gut contents or feces of Triatoma captured in nature and fed or not with normal rabbit blood in the laboratory, was intraperitoneally injected into mice, with the following results as to infection rate.

Table XI. Infection rates in mice by different means

Number of mice inoculated	Material used	Number of mice with positive result	Infection rate
80	gut contents	69	86.3%
3	feces	2	66.6%

We thus see that the percentage of infection is fairly high, and the negative results obtained in some cases are evidently due to the rare occurrence of the metacyclic trypanosome form in the injected material, so that, even if the infection was positive it could not be recognised easily, owing to the slow multiplication of the parasites in the mammalian blood. It seems very probable that when the infective forms are present in great numbers in the materials injected, the result is always positive. Thus in the species before us, the infective forms present in the insect gut can develop into typical trypanosomes in the mammalian blood by intraperitoneal injection.

2. By Subcutaneous Inoculation

Subcutaneous inoculation with the Triatoma gut contents was done on two mice and in one of them the result was positive.

b. Transmission Under Natural Conditions

We will now turn to the important question of how infection is effected under natural conditions. Generally speaking, trypanosome infection in nature is in two ways, depending chiefly on the distribution of the developmental forms, especially of the metacyclic trypanosome form in the insect body,

i) inoculation through bite,

ii) contamination by feces containing infective forms.

To the first category belong cases of infection through the intermediation of the salivary gland or proboscis of insects, by which the infective forms are introduced into the mammalian host when bitten, as in the Trypanosoma of Glossina. To the second category belong cases in which the infective forms are produced chiefly in the hind part of the gut or migrate thither and discharged with the feces, which infect mammals either perorally or percutaneously, as in *Trypanosoma cruzi* transmitted by several reduviid bugs. In the species before us it is highly probable that mammalian infection takes place by the second of the two ways just mentioned, since the infective forms are not found in the salivary gland or the proboscis but are produced in the hind part of the gut and discharged with the feces.

1. Infection by Bite

Perhaps a brief of what is known in *Trypanosoma cruzi*, biologically closely resembling our species, will help us. Chagas (1909) first pointed out that *T. cruzi* can be transmitted by the bite of infected bugs (*Triatoma megista*), in whose body cavity and salivary glands metacyclic trypanosome form appears. Brumpt was, however, unable to find this form in the parts mentioned even of bugs with a heavy intestinal infection. Torres (1915) succeeded in infecting mammals by allowing the bugs to bite through gauze, which prevented fecal contamination of the skin, but he failed to demonstrate the flagellates in the coelomic fluid of infected reduviids. Neiva (1913), working on the transmission of canine piroplasmosis by the bite of *Ripicephalus sanguineus*, infected dogs with *Trypanosoma cruzi*. In one case, Blacklock (1914) could transmit *T. cruzi* by the bite of *Cimex lectularius*. In spite of these successful cases of transmission to mammals by bite, it is generally admitted that active development of *Trypanosoma cruzi* takes place in the mid- and hind-guts of reduviid and other bugs, and that the crithidial form and finally the metacyclic trypanosome form appear in the feces, while the salivary gland, contrary to the statement of Chagas, does not take any part. The natural infection may occur by the wound becoming contaminated with the feces of infected bugs or by ingestion of the feces, as in *Trypanosoma lewisi*. As stated above, successful infection with *T. cruzi* by mere insect bite is very questionable.

Experiments were made with *T. conorhini* by allowing infected insects to feed several times on mice, with strict control of fecal contamination, and the blood was examined daily.

Table XII. Number of bites permitted; Triatoma — mice

	Mouse bitten	No. 38	No. 39	No. 56	No. 60
Triatoma used	No. 10	9	3	5	6
	No. 13	7	7	4	6
	No. 20	6	4	4	5
	No. 21	10	1	4	6
	No. 22	6	5	3	5
	No. 49	2	1	1	
	No. 59	9	4		
	No. 61	7	2		
	No. 62	7	5	9	
	No. 64	3	6	1	
	No. 67	5	1	10	
	No. 63	4		2	
	No. 66	2		8	
	No. 72			7	1
	No. 73			2	
Total number of bites		77	42	68	29

Not all the Triatoma used did the biting, so that during about two months, from June to July 1929, mouse No. 38 had seventy seven bites by thirteen different Triatoma, No. 39 forty two by eleven different Triatoma, No. 56 sixty eight by thirteen different Triatoma, and No. 60 twenty nine by six different Triatoma. In none was infection achieved.

2. Infection per os

It seems natural that in some trypanosomes, infection by the ingestion of feces should be a most common occurrence in nature. In *Trypanosoma cruzi* it is thought that this may be the case, and according to Brumpt (1913) and Mayer and Rocha Lima (1914), mice can be infected with *T. cruzi* by placing some infected blood on the mucous membrane of the mouth.

To clear up this point, the gut contents of three Triatoma containing numerous metacyclic trypanosomes, emulsified with saline water and centrifuged, were fed several times to two mice with a small pipette, carefully preventing vomiting and avoiding injury. Blood examination on the next day showed infection in both. In one, however, the trypanosomes disappeared three days after their first appearence, whereas in the other the infection lasted for at least eleven days, further blood examination not being undertaken. It can be said with certainty that oral infection by the ingestion of infected feces must therefore be admitted to be possible in nature in *Trypanosoma conorhini*.

3. Percutaneous Infection

This mode of infection is also quite possible for those trypanosomes whose metacyclic trypanosome forms are contained in the feces of insects. The first experiment was made on the intact skin of a mouse fixed with the abdomen down, by placing infected feces on the carefully shaved back and retaining them until dry. The result was negative. Then, four mice (Nos. 19, 20, 76, 77) were fixed with the back down and the shaved and scarified abdomen was smeared several times with the emulsion of infected gut contents, which were retained for three hours and twenty minutes. One of them (No. 77) showed a very slight infection on the eleventh day after the experiment. As in only one of the two control mice into which the same material was injected intraperitoneally, showed a very slight infection, the material used in this experiment must have contained only a small number of metacyclic trypanosome form. From the single successful case mentioned above, we may conclude that infection may take place in nature through skin wounds. Recently Dias (1932) has reported some cases of successful infection in *Panstrongylus megistus* (=*Triatoma megista*) when the clear excretion of the Malpighian tubes, which contains the flagellates, during the first hours after feeding, was placed on the intact skin of the back neck of guinea-pigs.

c. General Considerations on the Infection Route in Nature

The experiments mentioned above prove that *T. conorhini* can readily develop into typical Trypanosoma in the mammalian blood, so that it is permissible to suppose that natural infection is effected by one or other of the several experimental methods dealt with above.

Since this trypanosome develops in the posterior gut portion of invertebrates, infection through bite probably does not take place in nature, and my experiments gave negative results. On the other hand, the appearance of the metacyclic trypanosome form in the feces, points to its importance in this respect. As a matter of fact Triatoma bite is quite bad and the puncture followed by abrasion due to itching may open an easy way to infection.

The bitten animal may also lick the affected portion and incidentally ingest the parasites. It is not clear in which portion of the alimentary canal the parasites migrate into the blood stream, but it may occur at any portion of the mucous membrane except perhaps that of the stomach. To know something about the resistance of metacyclic trypanosome form to the gastric juice, an emulsion of the gut contents containing numerously the metacyclic trypanosome form was mixed with artificial gastric juice (N/10 HCl containing 0.4% pepsin) in various proportions and intraperitoneally injected into mice at varying intervals of incubation at 37°C. Unfortunately, all the mice died the next day, with the exception of one, which was inoculated with a mixture of 0.2 cc each of the artificial gastric juice and the flagellate emulsion and incubated for 1 minute and showed the infection on the next day. The death of these mice

was probably due to HCl, since the control which received only physiological salt solution or flagellate emulsion survived. Although my experiments on this point is too meagre to justify any conclusion, the infective forms of this species may penetrate the mucous membrane at any portion other than the stomach. At any rate, I am of opinion that peroral infection of this trypanosome is also possible in nature, as it actually occurred in one of my experiments.

Although as above shown, percutaneous or peroral infection is the most probable occurrence in nature, the fact, that no naturally infected mammalian host has been found, is perhaps due to the low adaptation of this trypanosome to it. Since this trypanosome, as will be shown later on, does not undergo active multiplication in the mammalian blood, it is quite difficult to discover them in the peripheral blood stream in cases of slight infection. The apparent absence of natural infection in mammals may be due to this peculiarity.

B. INCUBATION PERIOD IN MAMMALS

The incubation period, i. e., the time which intervenes between inoculation and peripheral appearance of the trypanosomes in the blood, was determined by daily examination of fresh and stained thick films of the mouse blood infected by various methods.

a) Among fifty intraperitoneal inoculations, the trypanosome appeared in 38 cases on the next day, in 7 cases on the second day, in 3 cases on the third day, and in one case respectively on the seventh and eighth day after inoculation, and it was also found that the shorter the incubation period the larger the number of trypanosomes in the blood and their appearance more continuous, and vice versa.

b) For one subcutaneous inoculation with positive results, there is no exact record on this point. In one positive case of successful percutaneous infection, the trypanosomes appeared on the eleventh day but never afterward. In two successful cases of peroral infection, the parasites were present on the next day.

c) For the estimation of the minimum time necessary for the trypanosomes to appear in the peripheral blood, more rigorous blood examination was undertaken after intraperitoneal inoculation.

Experiment I (VII 7, 1931). Twenty hours after inoculation, a thick film showed 1 parasite per 100 fields; and the number after four hours more to 10 per 100 fields.

Experiment II (VII 20, 1931). The gut contents of several Triatoma emulsified with 2 cc of saline water, were injected into two mice, 0.2 cc into one and 1 cc into the other. Examination of fresh blood preparations made three hours and fourty minutes afterwards showed the parasites in both.

Experiment III (VII 30, 1931). The gut contents of two Triatoma emulsified with 3.5 cc of saline water, were injected into two mice, 1.5 cc into one and 0.5 cc into the other. Examination of fresh blood preparations showed the parasites three hours afterwards in the one which received the smaller dose,

and four hours and thirty minutes afterwards in the other. This difference may have been due to the different number of metacyclic trypanosomes introduced.

These experiments appear to show that this flagellate is able to adapt itself to mammalian blood in as short a time as three hours after its introduction. As to whether the transformation into typical Trypanosoma is complete at this time, can not be ascertained owing to the difficulty of detecting the comparatively few examples present in smear preparations at so early a period of infection. My result agrees with Lafont's finding in *Trypanosoma boylei*, which appeared in the peripheral blood three to four hours after intraperitoneal injection, indicating that this trypanosome does not invade the tissue of the host to multiply therein, as *Trypanosoma cruzi* does.

C. INFECTION COURSE

In regard to the infection course in the mammalian blood, two fundamental types, acute and chronic, are known. In one case the parasites multiply progressively or even rapidly until the death of the host, while in the other, they continue to appear for a long time multiplying more or less, but at last disappear from the blood, imparting absolute or relative immunity to the host. Each case is characteristic for each *Trypanosoma* species.

I propose to describe my observations on *T. conorhini*, which throw some light on this point. A thick film of two drops of the tail blood of infected mice, 1.5 cm in diameter, was prepared and countings were made for 100 microscopic fields with the optic combination 1/12 × Komp. 4 Zeiss. I was forced to adopt this somewhat inexact method owing to the difficulty of obtaining sufficient supply of blood from such a small animal as the mouse.

a. Duration of Infection

The duration of infection varied from one to thirty six days, depending on the number of the trypanosomes in the blood. Heavy infections, in which more than 50 parasites were present per 100 fields daily, lasted generally for a comparatively short period of 11–16 days or 12.8 days on the average, during which the parasites appeared continuously but then disappeared more or less suddenly. In moderate infection, in which 20–50 parasites were present per 100 fields daily, the appearance of the parasites was also continuous for 13–25 days or 19 days on the average. In slight infections, with less than 20 parasites (sometimes only one) per 100 fields, the appearance of the parasites was interrupted but often lasted for a comparatively long period, viz. 15–27 days or 20.1 days on the average. In extremely slight infections, the parasites often appeared only on a single day or 2–3 times during a long period.

Table XIII. Average duration of infection

Grade of infection	heavy	moderate	slight
Parasites per 100 fields daily	more than 50	20-50	less than 20
Average duration in days	12.8	19	20.1
		19.4	

In some mice which died 1-6 days after infection, the parasites appeared in fairly large numbers.

b. Numerical Variation in the Course of Infection

As a result of enumeration by the above method, it was found that the number of parasites varied from over 100 to only 1 per 100 microscopic fields. Although the numerical variations are rather irregular type in this trypanosome, it is worth noting that it never multiplies in so marked a manner as *T. lewisi* and other mammalian trypanosomes, in which multiplication takes place gradually or often rather suddenly even when the initial number was very small. In this species, however, the subsequent number is mostly no greater than in the early stage, and do not undergo marked increase in the course of infection. In heavy infections, the number decreases suddenly and reaches zero in a few days, while in light infections the decrease to zero is very gradual. It is, however, necessary to determine accurately whether or not multiplication takes place at all. This question should be viewed from several angles, but confining ourselves to mere number for the present, more or less multiplication seems to take place, since even where the parasites are found only in small numbers on the next day after inoculation, they are more numerous on the second to fifth day, although no further marked change occurs. At any rate, after the first day the number of individuals remains nearly constant; only in heavy infections it tends to diminish comparatively rapidly in the blood. Perhaps an antibody is produced, preventing further multiplication.

c. Relation between the Dose Inoculated and the Number of Trypanosomes Appearing in the Blood

We have seen above that the daily number of the trypanosomes depends upon the number present at an early stage of infection. What factor controls this number? The following experiments were made to ascertain whether or not this number corresponds to that of the metacyclic trypanosome form inoculated.

In experiment I, where two mice were inoculated with doses of the relative amount of 1 : 3, the one which received the larger dose showed several times more parasites than the other, although not exactly proportional to the dose injected; and in experiments II and III, the number was nearly proportional to the dose given, viz. 1 : 5 and 1 : 3 respectively. I therefore believe that in this species the number which develops in the mammalian blood depends largely

Table XIV. Numerical variations in course of infection in mouse

Degree of infect.	Mouse	Day of inoculation	Number of trypanosomes per 100 fields on each day																							
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Heavy	122	VII 20, '31	51	126	109	82	78	78	67	71	81	91	42	22	3	0										
	120	VII 7, '31	16	156	95			127	173	70	90	19	19	1	0											
	110	XI 10, '30	111	159	81	68	83	81	died																	
	68	V 2, '30	41	85	89	64	11	81	51	62	50															
	90	XII 5, '29	57	72	44	13	died																			
	88	X 30, '29	53	70	79	62	68	33	51	51	52		47	3	0											
	87	X 26, '29	69	142	59	84	40	108	75	33	3	2	1	0												
	82	X 15, '29	122	105	111	110	115	99	87	103	61	58	3	3	2	4	1	1	0							
	83	X 15, '29	57	103	69	70	98	54	31	61		33	23	20	13	0										
Moderate	132	IX 3, '31	4	21	8	23	15	12	29	12	19	8	2	4	15	10	1	died								
	121	VII 20, '31	6	27	38	31	30	17	17	21	16	15	14	20	4	0										
	73	VIII 28, '29		37	18	14	11	15	9	29	27	27	27	31	21	23	17	8	20	31	14	8	0	0	2	0
	71	VIII 23, '29		27	26	26	14	25	36	20	16		12	5	8	2	16	8	2	5	1	4	2	0		
	72	do		38	21	21	29	31	28	15	4	0	0	5	3	5	10	1	0							
	70	VIII 2, '29		19	25	46	died																			
	92	XII 14, '29	39	died																						
Light	86	X 25, '29	1	0	2	4	5	6	11	8	7	15	10	7	5	2		5	9	4	1	0				
	84	X 16, '29	4	8	4	4	6	3	4	8	4	6	7	6	2	5	5	17	4	0	2	2	0			
	79	X 9, '29	1	10	7	10	6	5	1	10	6	9	20	10	3	4	7	8	9	3	2	4	0	0	0	1
	125	VII 30, '31	3	5	8	5	9	7	12	7	5		7	7	11	10	3	0								
	85	X 25, '29	0	16	15	2	0	0	0	0	1	1	0	0	0	8		0	0	2	0	0	1			
	103	V 9, '30	0	2	7	4	1	3	1	3		7	3	3	3	1	0		1	1	1	0				

Table XV. Infection course in mice inoculated with different doses, as shown by the number of trypanosomes per 100 fields

Exp. I. XI 10, 1931.

Mouse	Dose inocul. per 10 gm of body weight	XI 10	11	12	13	14	15	16	17
No. 109	0.5 cc	inoc.	0	1	0	0	0	0	0
No. 110	1.5 cc	inoc.	111	159	81	68	83	81	died

Exp. II. VII 20, 1931.

Mouse	Dose inocul. per 10 gm of body weight	XII 20	21	22	23	24	25	26	27
No. 121	0.2 cc	inoc.	6	27	38	31	30	17	17
No. 122	1.0 cc	inoc.	51	126	109	82	78	78	67

	VII 28	29	30	31	VIII 1	2	3	4	5	6	7
No. 121	21	16	15	14	20	4	1	0	0	0	1
No. 122	71	81	91	49	22	3	0	1	0	0	0

Exp. III. VII 30, 1931.

Mouse	Dose inocul. per 10 gm of body weight	VII 30	31	VIII 1	2	3	4	5	6	7
No. 125	0.5 cc	inoc.	3	5	8	5	9	7	12	7
No. 123	1.5 cc	inoc.		15	21	26	22	30	8	19

	VIII 8	9	10	11	12	13	14	15
No. 125	5		7	7	11	10	3	0
No. 123	5		0	0	0	0	0	0

on the number of infective individuals inoculated and does not undergo any marked change afterwards.

d. Infection Course in Young Mice

As to immunity according to age there are two contradictory opinions, that it increases, and that it decreases with advancing age.

It seemed to me that, since the trypanosome before us does not undergo marked multiplication in adult mice, it might show different results in animals less than 1 month old.

Table XVI. The numerical variations in young mice

Mouse No. 100. V 2, 1930.

Date	V 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Number of trypanosom. per 100 fields	inoc.	3	10	7	7	5	9	13	4	4	+	+	11	6	+	5	4	?	1	1

Mouse No. 101. V 2, 1930.

Date	V 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Number of trypanosom. per 100 fields	inoc.	25	66	86	15	48	78	22	35	35	64	+	+	+	0	?	?	0

The table shows that contrary to expectation there is no difference between adults and youngs as to the reproductive capacity of the trypanosome.

D. SUB-INOCULATION

To keep up the strain of this trypanosome, if possible, sub-inoculations were made from mouse to mouse, but the first sub-inoculation resulted in a diminution of the parasites or their complete disappearance, so that no further inoculation was possible, as may be seen from the following.

Case I. The blood of mouse No. 30 on the third day of infection, containing a large number of trypanosomes, was intraperitoneally injected into mouse No. 31; only a few parasites appeared on the 5th and 8th days, but none afterwards.

Case II. Mouse No. 32 inoculated from the same source as in case I; a few trypanosomes only on the 3rd and 18th days.

Case III. Mouse No. 112 inoculated from mouse No. 26 on the 3rd day of infection; the parasites appeared only thrice during 34 days with long interruption.

Case IV. Mouse No. 113 inoculated from the same source as in case III on the 17th day of infection; the trypanosomes appeared on the 2nd and 3rd days and only once during 20 days thereafter.

Case V. Mouse No. 108 received sub-inoculation from mouse No. 23 on the 5th day of infection; no trypanosomes appeared during 20 days afterwards.

Case VI. Mouse No. 102 received sub-inoculation from mouse No. 2 on the 11th day of infection; parasites appeared only on the 13th day during 48 days.

Case VII. Mouse No. 102 sub-inoculated from the same source and on the same day as in case VI; parasites appeared only on the 9th day during 48 days.

It is important to inquire whether the results of sub-inoculation are influenced by its stage in the first generation, since there may possibly be some difference in the reproductive power of the trypanosome according to the stage

of infection, and furthermore, the production of an immune substance being assumed, it may be present in larger amount at a later stage and being introduced with the trypanosomes into a second host, may affect the multiplication of the parasites unfavourably. Taliaferro (1924) has pointed out that in rats infected with *T. lewisi*, the reproduction-inhibiting-substance is produced about 10 days after the commencement, and the destructive substance on the 18th to 20th day of infection, so that if sub-inoculation is made after the 10th day of infection, the reproduction is completely inhibited, whereas if normal serum is used, infection proceeds in a typical manner. In my own case, there was no difference in the result, whether the sub-inoculation was carried out on the 3rd day after the first infection, when it may be assumed that the trypanosomes have lost none of its vitality and the production of the immune body is practically negligible, or on the 11th to 17th day, when the trypanosomes are presumably matured and the immune body is present in larger amount. It seems to me highly improbable that the animals used in these experiments for sub-inoculation fortuitously happened to be possessed of special resistance to this trypanosome. Hence it seems reasonable to conclude that this trypanosome species is not well adapted to life in mammals, so that sub-inoculation results in infection of very short duration.

E. INFLUENCE OF SPLENECTOMY UPON INFECTION

There are many reports according to which the spleen is related in some way or other with the production of immunity to protozoa. Regendanz and Kikuth (1927) has pointed out that in splenectomized rats the reproductive period of *Trypanosoma lewisi* can be prolonged for 2 or 5 days. Taliaferro, Cannon and Goodloe (1931) have reported that in young healthy *Bartonella*-free rats with *T. lewisi*, splenectomy does not markedly influence the formation of the reproduction-inhibiting antibody if the operation is performed between 7 days before infection and 41 days after it, but in a similar series of young *Bartonella*-infected rats, splenectomy sometimes markedly prolongs the normal cycle of trypanosome reproduction or makes it recurrent, etc. Vassiliadis (1930) found that in the spontaneous infection of Sodoku-Spirillum among harvest mice and field mice, the Spirillum increased in number after splenectomy, and that the natural refractoriness of harvest mice to *T. lewisi* and of rabbit to *Eperythrozoon coccoides* could be overcome by splenectomy.

Whether something similar can be said of *T. conorhini* is the question before us.

a. Inoculation of Splenectomized Mice

The gut contents of five Triatoma were injected intraperitoneally into three splenectomized mice and one control.

Table XVII. Inoculation of splenectomized mice

Mouse	Spleen	Result	Grade of infection
No. 41	exstirpated	positive after 6 days	Slight (re-inoculated)
No. 42	do	„ 15 days	do
No. 43	do	„ 2 days	do
No. 40	control	negative	

All the splenectomized mice showed positive results and the control negative, and since the same injection material was used for both, we may conclude that in *T. conorhini* infection is effected more easily by splenectomy.

b. Re-Inoculation in Splenectomized Mouse

One of the mice used in the above experiment (No. 41) which showed slight infection, was re-inoculated on the 9th day after the first. On the next day the parasites appeared in fairly large numbers and continued to appear for 113 days with interruptions (122 days in all).

Table XVIII. Infection course in mouse No. 41. VI X, 1929

Date	VI 23	24	25	26	27	28	29	30	VII 1	2	3	4	5	6	7	8	9	10
Blood finding	spleen exstir.	1st inoc.		–	–	–	–	–	+	+	2nd inoc.	+	+	+	+	+	+	+

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29 ....
+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	1	+	not examined

VIII 20	21	22	23	24	25	26	27	28	29	30	31	IX 1	2	3	4	5	6	7	8	9	10
	+	+	+	+	+	+	–	+	+	+	+	+	+	+	–	+	–	–	+	–	–

11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	X 1	2
+	–	+	+	+	–	+	+	–	–	+	–	–	–	+	–	+	–	–	+	+	–

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
+	–	+	–	–	–	–	+	+	+	+	+	+	–	–	+	–	+	–	+	–	+

25	26	27	28	29	30	31
–	–	|	–	–	–	–

c. Influence of Subsequent Splenectomy upon the Further Course of Infection

Experiments were performed on two lines.

1) Splenectomy performed between inoculation and the appearance of the parasites in the blood.

Table XIX. Influence of splenectomy upon the appearance of parasites

Mouse	Date of inoculation	Date of splenectomy	Days between inoculation and splenectomy	Result
No. 40	VI 24 ('29)	VII 12	18	negative
No. 75	X 4 ('29)	X 12	8	,,
No. 76	X 4 ('29)	X 12	8	,,
No. 77	X 4 ('29)	X 12	8	positive 3 days after
No. 80	X 9 ('29)	X 18	9	negative

As shown in above table, five mice were splenectomized 8–18 days after inoculation, but before the appearance of the parasites in the blood, and only of them, No. 77 yielded positive finding 3 days after splenectomy. Since there is no doubt that infective forms were present in the injections, the parasites failed to appear for some time, and splenectomy could not induce their appearance in the blood. Even the one positive finding above mentioned was probably not due to multiplication brought about by the operation, as it lasted for a single day. I am therefore of opinion that the reproductive capacity of this trypanosome is not enhanced by splenectomy.

2) Splenectomy at the time of appearance of the parasites or afterward. Five infected mice were splenectomized. In slight infections, the prevailing feature was not markedly affected by the operation, i. e., if the infection was slight before the operation, it continued to be so afterward. It is, however, especially noteworthy that if the parasites appeared almost continuously in the blood, though small in number, the duration of infection was notably prolonged by splenectomy, though no tendency to increase in the number of parasites was apparent; the infection may last for more than 60 days, whereas normally the duration is as a rule 15–36 days. This I think is due to inhibition or reduction of the production of destructive antibody by splenectomy. Similarly, Taliaferro (1931) demonstrated that in young normal rats (*Bartonella*-free or infected) *T. lewisi* infection lasts for 40.6±1.7 days on the average in contrast to 84.4±6–112.5±6.8 days in splenectomized young rats (*Bartonella*-free or infected) and 115.6±15.6 days in old splenectomized, *Bartonella*-infected rat.

Table XX. Influence of splenectomy upon the continuous appearance of the parasites

Mouse	Date of inoculation	Prevalent feature of parasites	Date of splenectomy	Condition after operation	Total duration of infection
No. 2	VIII. 7 ('28)	slight but continuous	VII. 13	slight but continuous, lasted for 61 days	67 days
No. 58	VII. 3 ('29)	interruptedly	VII. 12	interruptedly, lasted 20 days, as far as observed	29 days
No. 74	X. 4 ('29)	appeared only once	X. 12	very rare, only twice during 15 days	
No. 78	X. 8 ('29)	interruptedly	X. 18	interruptedly, but lasted 57 days	67 days
No. 81	X. 9 ('29)	only once	X. 18	only once after splenectomy	

Table XXI. Prolonged duration of infection in splenectomized mouse

(No. 78) X–XII, 1929

Date	X 8	9	10	11	12	13	14	15	16	17	18*	19	20	21	22	23
Numb. of parasites per 100 fields	inoc.	0	1	1	0	3	2	0	0	3	0	1	3	2	0	1

24	25	26	27	28	29	30	31	XI 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	0	1	1	2	3	3	2	3	4	1	4	0	1	0			2	2	1	2	2	0	0

17	18	19	20	21	22	23	24	25	26	27	28	29	30	XII 1	2	3	4	5	6	7	8	9	10
4	1	2	1	1	2	1	1	1	0	1	0	0	2	1	1	1	0	0	1	0	0	1	1

11	12	13	14	15	16	17	18
1	0	0	1	0	0	0	0

* splenectomized.

d. Summary of the Results of Splenectomy Experiments

The results of the above experiments may now be summarized. 1) Splenectomy seems to make the infection more easy; 2) splenectomy has no marked influence upon the further multiplication of the parasites, if the infection had been established already; 3) it can not induce the appearance of the parasites in the blood, if they were not already present there. In fact, splenectomy performed at different times in the course of infection has no marked influence upon the reproduction of this trypanosome in the mammalian body, the prevalent character of infection remaining essentially unchanged by the operation. This again brings us back to the low adaptation of this trypanosome as mammalian parasite; its

reproduction in mice is inhibited a priori and the inhibition is not altered by splenectomy. Of special interest also is the great prolongation of the duration of infection without concomitant increase in the number of parasites by splenectomy. This may possibly be due to the influence of splenectomy upon the mode of production or action of trypanocidal or lytic substance, the presence or appearance of which in normal mice is suggested by the frequent occurrence of degenerated forms in the course of infection and the disappearance of parasites from the blood.

F. INFLUENCE OF HUMAN AND ANIMAL SERA UPON THE INFECTION OF MAMMALS BY *TRYPANOSOMA CONORHINI*

Since Laveran (1902) discovered the therapeutic value of the injection of normal human serum into mice suffering from Nagana, many reports have been published on the subject. Rosenthal and his collaborators (1923–1929), after prolonged study from different viewpoints, reached the conclusion that human serum is inactive by itself but contains a substance which can be converted into an active trypanocide in the animal body by the aid of the reticulo-endothelial system. Contrary to the almost unanimous view of many investigators including the above mentioned authors, that human serum has no harmful action in vitro on the pathogenic trypanosomes, Yorke, Adams and Murgatroyd (1929, 1930) found that it rapidly destroyed in vitro at 37°C *Trypanosoma rhodesiense*, *T. congolense* *T. equiperdum* and a *rhodesiense*-like strain recently isolated from a sleeping sickness case, although it had no appreciable trypanocidal action on an old laboratory strain of *T. gambiense*, and concluded that " man's immunity to infection with the pathogenic trypanosome of stock, and his relative susceptibility to *T. gambiense* are bound up with this property of his serum ". As to the question why *T. rhodesiense*, also isolated from man, is susceptible to his serum, they are of opinion that *T. rhodesiense* (as also *T. gambiense*) has originally been derived from *T. brucei* and introduced by *Glossina morsitans* from game into certain men whose sera lost the trypanocidal property owing to certain defects of body condition such as liver disease, improper dietary etc., and thus acquired the power of resistance to their sera, but that this power is of so labile a character that it's acquisition takes only a short time in the human body and its loss as short a time during the passage through animals. Corson (1930) reported that *T. rhodesiense* is more resistant to human serum in an early stage after its isolation from man than after many passages through animals. These observations seem to involve the idea that the trypanosome resistant to human serum can infect the human body, which means vice versa that the susceptibility of the trypanosome to human serum increases by passage through animals. It appears therefore possible to judge of the infectivity of any trypanosome by its susceptibility to the serum of man or animals.

I have therefore carried out certain experiments on the susceptibility of this primitive *T. conorhini* to various animal sera, with the hope that they might help in the finding its still unknown natural vertebrate host.

a. EFFECT OF HUMAN SERUM ON THE INFECTION OF *T. CONORHINI*.

It is supposed that the biological character of protozoa transmitted by insects and especially the action of drugs and other agents may be different in the mammalian and the insect form. Therefore, experiments on the action of various sera on any trypanosome should be performed in two directions: first, as to their action in preventing infection, or action on the metacyclic trypanosome form, and secondly, as to their influence on the infection course in the vertebrate host.

The sera used in these experiments have been proved to be definitely trypanocidal for *T. gambiense* in the mouse.

1. Action of Human Serum on the Metacyclic Trypanosome Form in Mice

In a mouse subcutaneous injection of 0.2 cc of human serum per 10 gm of body weight was done just after intraperitoneal inoculation with the gut contents of Triatoma and the trypanosomes appearing in the peripheral blood was counted daily by the usual method, commencing on the next day after inoculation, with the following results.

Table XXII. Results of inoculation after or without injection of human serum

No. of Exp.	Mouse	Human serum per 10 gm of body weight	Infection and its course
I	No. 114	0.2 cc	Negative
	No. 115	control	Slight infection
II	No. 85	0.2 cc	Very slight infection with interrupted appearance of parasites
	No. 86	control	Slight but with continuous appearance of parasites
III	No. 124	0.2 cc	Very slight infection with interrupted appearance of parasites
	No. 125	control	Slight but with continuous appearance of parasites
IV	No. 151	0.2 cc	Slight but with continuous appearance of parasites
	No. 152	0.2 cc	Ditto
	No. 153	control	Moderate infection

We thus see that with one exception, all the mice used, treated and devoted to the controls, became infected, so that we have to conclude in *T. conorhini* injection of normal human serum can not absolutely prevent infection by the insect form. But it is to be noted that in all the positive cases, the infection was very slight and sometimes the appearance of the parasites was interrupted, whereas in the controls the appearance was always more steady.

Table XXIII. Infection course after or without injection of human serum, shown by the number of trypanosomes per 100 fields

Experiment I. X 25, 1929

Mouse	Human serum per 10 gm of body weight	X 25	26	27	28	29	30	31	XI 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
No. 85	0.2 cc	inoc.	0	0	2	2	0	0	0	0	1	1	0	0	0	8		0	0	2	0	0	1	0	0	0	0
No. 86	control	do	1	16	15	4	5	6	11	8	7	15	10	7	5	2		5	9	4	1	0	0	0	0	0	0

Experiment II. XI 27, 1929

Mouse	Human serum per 10 gm of body weight	XI 27	28	29	30	XII 1	2	3	4	5	6
No. 114	0.2 cc	inoc.	0	0	0	0	0	0	0	0	0
No. 115	control	do	5	9	4	7	5	3	6	17	5

Experiment III. VII 28, 1930

Mouse	Human serum per 10 gm of body weight	VII 28	29	30	31	VIII 1	2	3	4	5	6	7	8
No. 124	0.2 cc	inoc.	0	0	2	0	0	0	2	0	0		0
No. 125	control	do	3	5	8	5	9	7	12	7	5		7

Experiment IV. VI 9, 1932

Mouse	Human serum per 10 gm of body weight	VI 9	10	11	12	13	14	15	16	17	18	19	20	21	22
No. 151	0.2 cc	inoc.	3	8	6	2	13	7	11	2	8	11	9		2
No. 152	0.2 cc	do	1	6	4	1	4	7	4	3	5	3	8		4
No. 153	control	do	13	44	47	17	23	27	40	22	13	34	19		7

These results seem to justify the conclusion that human serum has certain unfavourable effects on the metacyclic trypanosome form in mammals.

2. Influence of Human Serum upon the Infection Course in Mammals

Human serum was injected into mice 6–14 days after the appearance of the trypanosomes in the blood. Table XXIV shows that the infection course was not altered thereby, at least so markedly as in infections with the old

strain of *T. gambiense*, in which the infection is usually soon brought to an end by such injections. It therefore appears that the human serum has no action upon the trypanosomes which have established themselves in the mammalian body, contrary what happens with the metacyclic trypanosome form. The mammalian and insectan forms therefore appear to have different biological properties, at least in regard to susceptibility to human serum injected into the mouse.

Table XXIV. Infection course after injection of human serum after appearance of the trypanosomes in the blood.

Experiment I. X 16, 1929. Mouse No. 84

Date	X 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	XI 1	2	3	4	5	6
Number of parasites per 100 fields	inoc.	4	8	1	4	6	3	4	8	4	6	7	6	2	5	5	17	4	0	2	2	0
Human serum	0.2 cc																					

Experiment II. XI 27, 1929. Mouse No 115

Date	XI 27	28	29	30	XII 1	2	3	4	5	6	7	8	9	10	11
Number of parasites per 100 fields	inoc.	5	9	4	7	5	3	6	17	5	5	2	3	1	0
Human serum	0.2 cc														

b. Effect of Various Animal Sera on the Infection of *T. conorhini*.

Only few investigators have obtained positive results on the trypanocidal action of animal sera. Such an action on Nagana trypanosomes noted by Laveran (1904) with the serum of the baboon has been confirmed later and extended by Mesnil and Leboeuf (1910) to the sera of the mangabey and mandrill for certain pathogenic trypanosomes, whereas the sera of *Macacus*, *Cynomolgus*, *Cercopithecus* and anthropoid apes yielded negative results. My own experiments on this line have been performed with the sera of horse, dairy cattle, Formosan native cattle, water buffalo, dog, hog, albino rat, rabbit, fowl, and pigeon on the *T. conorhini*, presumably a very primitive form as regards its adaptation to vertebrate hosts; and the trypanosomes used were those of the metacyclic form, as with the mammalian form enough infected mice could not be obtained conveniently. The technique was exactly the same as with human serum, viz. 0.2 cc of each animal serum per 10 gm body weight of the mouse was subcutaneously injected just after inoculation with the gut contents of infected Triatoma.

Table XXV. Infection course after subcutaneous injection of various animal sera, as shown by the number of trypanosomes per 100 microscopic fields

Experiment I. VII 6, 1932

Mouse	Source of serum	VII 6	7	8	9	10	11	12	13	14	15	16
No. 139	horse	inoc.	died									
No. 140	do	do	0	0	0	1	1	0	0	0	0	1
No. 141	water buffalo	do	0	0	2	2	1	1	1	2	1	0
No. 142	do	do	0	1	0	1	0	1	2	0	3	1
No. 143	native cattle	do	0	0	0	0	0	0	died			
No. 144	do	do	0	3	0	0	2	2	died			
No. 145	hog	do	1	7	6	5	8	8	5	5	died	
No. 146	do	do	3	9	14	12	7	8	7	11	died	
No. 147	control	do	1	18	35	41	39	31	35	16	died	

Experiment II. IX 5, 1932

Mouse	Source of serum	IX 5	6	7	8	9	10	11	12	13	14	15	16
No. 153	horse	inoc.	12	9	10	3	12	7	12	2	7	6	11
No. 154	do	do	2	5	5	1	4	6	2	1	1	8	3
No. 165	rabbit	do	2	1	1	1	4	1	0	1	1	killed	
No. 166	do	do	0	2	2	3	6	1	1	0	4	killed	
No. 157	control	do	13	44	47	17	23	27	40	22	13	34	19

Experiment III. IX 27, 1932

Mouse	Source of serum	IX 27	28	29	30	X 1	2	3	4	5	6	7	8	9	10	11	12
No. 167	buffalo	inoc.	9	18	18	19	15	21	21	19	11	8	26		14	12	14
No. 168	do	do	5	12	19	7	23	13	18	20	24	22	28		21	14	2
No. 169	fowl	do	0	0	0	0	0	0	0	0	1	0	0		1	0	0
No. 170	do	do	0	0	0	0	0	0	0	0	0	0	0		0	0	0
No. 171	control	do	17	28	26	28	34	33	37	34	19	26	33		3	1	0

Experiment IV. X 10, 1932

Mouse	Source of serum	X 10	11	12	13	14	15	16	17	18	19	20	21
No. 172	dairy cattle	inoc.	0	0	1	0	1		0	0	0	0	1
No. 173	do	do	0	0	0	1	0		2	0	0	0	1
No. 175	control	do	1	4	0	2	3		4	3	2	6	6

Experiment V. XI 30, 1932

Mouse	Source of serum	IX 29	30	X 1	2	3	4	5	6
No. 185	pigeon	inoc.	0	0	0		0	0	
No. 186	do	do	2	0	6		2	6	
No. 187	dog	do	0	0	0		0	0	
No. 188	do	do	0	1	0		?	0	0
No. 189	albino rat	do	0	0	1		0	1	
No. 190	do	do	0	0	0		1	0	0
No. 191	control	do	0	0	1		0	0	

The results are summarized as follows.

i) Horse serum. In Experiment I, one of the two mice injected with this serum just after inoculation died on the next day from an unknown cause and the other showed a very slight infection, the control showing a relatively heavy infection. In Experiment II, both of the treated mice showed slight steady infection, while in the control the infection was more severe. Horse serum appears to have some unfavourable action on infection by this trypanosome.

ii) Water buffalo serum. In Experiment I, the treated mice showed very slight infection in contrast to the control, in which the infection was quite heavy. In Experiment III, the infection was moderate in the treated mice but more severe in the control. Water buffalo serum also appears to have some unfavourable action on the parasites.

iii) Formosan native cattle serum. Of the two treated mice, one died 7 days after inoculation without showing any sign of infection, and the other showed a very slight infection, whereas in the control the infection was fairly steady (Experiment I). The serum of Formosan native cattle apparently acts more definitely on the parasite than the two foregoings.

iv) Dairy cattle serum. The treated mice showed very slight infection; in the control the infection was also slight, though more steady (Experiment IV).

v) Hog serum. In the treated mice the infection was slight but steady, in the control, more severe (Experiment I).

vi) Rabbit serum. In the treated mice the infection was only slight, in the control moderate (Experiment II).

vii) Dog serum. Only one of the two treated mice showed very slight infection, in the control the result was similar.

viii) Albino rat serum. Both the treated mice and the control showed very slight infection (Experiment V).

ix) Pigeon serum. One of the treated mice showed no infection, while the other and the control showed slight infection (Experiment V). In this as in vii and viii, the material used contained only a few infective forms of the trypanosome, so that the results is not unequivocal, but it appears to me certain that the action of these sera is not absolutely destructive.

x) Fowl serum. Of the two treated mice one was immune and the other

showed a very slight infection, whereas the control was heavily infected (Experiment III). This is an interesting result and is confirmed by the result obtained in vitro, as will be dealt with in another chapter. In fact I have come to the conclusion that fowl serum is strongly trypanocidal.

c. Discussion on the Results Obtained in the Foregoing Experiments

Although none of the sera used by me proved to be absolutely trypanocidal, it is worth noting that almost all of them had some slight action to prevent infection, and that fowl serum showed the most definite action, so that we may conclude that the sera above enumerated have some unfavourable action on the metacyclic trypanosome form of *T. conorhini*. It is not clear, however, whether or not this action of the sera is analogous in its mechanism to the commonly accepted preventive action of normal human serum on pathogenic trypanosomes. It is conceivable that the sera act indirectly by increasing the vitality of the host and its general resistance against the infection, and further investigation is necessary to elucidate this point. My experiments have given no clue to the probable natural vertebrate host of this trypanosome.

G. IMMUNITY

Immunity or resistance to protozoan infection may be natural or acquired, and the latter may be brought about in certain host animals but not in others. Of great interest and value in this respect is the work of W. H. and L. G. Taliaferro (1922), who have shown in Trypanosoma, that certain substances may act a) by retarding the rate of reproduction of the parasites (reproduction-inhibiting substance), or b) by destroying them (destructive or lytic substance). With non-pathogenic trypanosomes, such as *T. lewisi*, both kinds of substances are produced, first the reproduction-inhibiting and later the lytic substance, whereas with pathogenic trypanosomes neither of the two substances is produced, resulting in acute, fatal infection, or only a resistance directed towards destruction is produced, as with *T. equinum* in the rat or with *T. rhodesiense* and *T. brucei* in the dog and guinea-pig, causing relapsing infection with the forms resistant to the antibody. For a numerical expression of the reproduction rate of the trypanosomes, they recommended the use of the coefficient of variation of the total length of the trypanosomes and for the destruction rate, their numerical prevalence in the peripheral blood. This method may also be utilised for the host adaptation of the parasite.

Observations and reflections with respect to this point on such a primitive trypanosome as *T. conorhini* in the mammalian host must be very interesting, especially to decide whether or not it really multiplies in mammals, and if it does, to what extent the multiplication goes on.

My experiments have proved that the mouse is subject to infection by this trypanosome, so that the question of absolute natural immunity may be ruled out.

In regard to the production of post-infection resistance, I want to consider 1) resistance developed in the course of infection, and 2) resistance against re-infection.

a. Resistance Developed in the Course of Infection

As already mentioned, this is either reproduction-inhibiting or destructive. In certain cases both kinds may be produced, while in others only one or neither of them is developed, and on this relation depends the pathogenic or non-pathogenic action of a trypanosome. Where both kinds are developed, the production of reproduction-inhibiting substance, as a rule, precedes that of the other which finally effects the complete disappearance of the parasites.

1. Is Reproduction-inhibiting Substance Produced in this Trypanosome Infection?

If the trypanosome increases in number and division is frequent during the infection, it is obvious that reproduction is going on. If, however, the destructive substance is produced in greater quantities, the increase in number may not be noticeable in spite of the possible occurrence of reproduction, so that non-increase in the number of parasites is not of itself an indication of non-reproduction. Taliaferro often found dividing forms in cases where reproduction was not completely inhibited.

As noted in a previous chapter, the numerical variation of *T. conorhini* in the blood stream is not marked, although during the first 2–5 days of infection a certain tendency to increase in number is apparent. But it must be noted as most remarkable that in the course of my numerous experiments on this trypanosome, I have never come across a dividing form even in cases of very heavy infection, so that one is justified in doubting if the tendency to increase in number mentioned above, really indicates reproduction at all.

I have adopted the indirect method of knowing the rate of reproduction proposed by the Taliaferros, and undertook the daily measurement of the length of one hundred individuals, or sometimes fifty owing to the small number present in the blood.

i) Variation in length. As previously given in detail, the total length of the trypanosome more or less variable at an early stage of infection, but the daily variation is generally not marked and growth goes on with the progress of infection, reaching the maximum on the third or fourth day, after which the body length remains nearly constant. Different in this respect is *T. lewisi*, in which small forms occur in the course of reproduction, the length difference between the largest and smallest ones amounting to more than 27 μ. Since *T. conorhini* does not show so marked an individual difference and constancy of length is reached in a comparatively short time, the variation seen at the early stage of infection is probably not due to division but due to different growth according to individuals. No dependable evidence is therefore forth-

coming from this source.

ii) Coefficient of length variation. Taliaferro (1923) noted that a sample of organisms taken from a population undergoing rapid reproduction, with constant production of young forms and intermediate growth stages, will exhibit much greater variability in size than a sample taken from a population in which little or no reproduction is going on and in which all the individuals are full-grown. He designated this variability with the value of coefficient of length variation obtained by the usual method, and thinks that 3% difference in coefficient of variation indicates no reproduction, whereas if it reaches 30%, the reproduction is at the maximum. The formula used to obtain the coefficient of variation (C. V.) is as follows:

$$\text{C. V.} = \frac{100\delta}{M},$$

in which δ is the standard deviation and M the mean. The mean is the average value, and is obtained by dividing the sum of the various measurements by the number of individuals ($\Sigma x/n$). In obtaining the standard deviation the following formula was used,

$$\delta = \frac{\Sigma x^2}{n} - M^2,$$

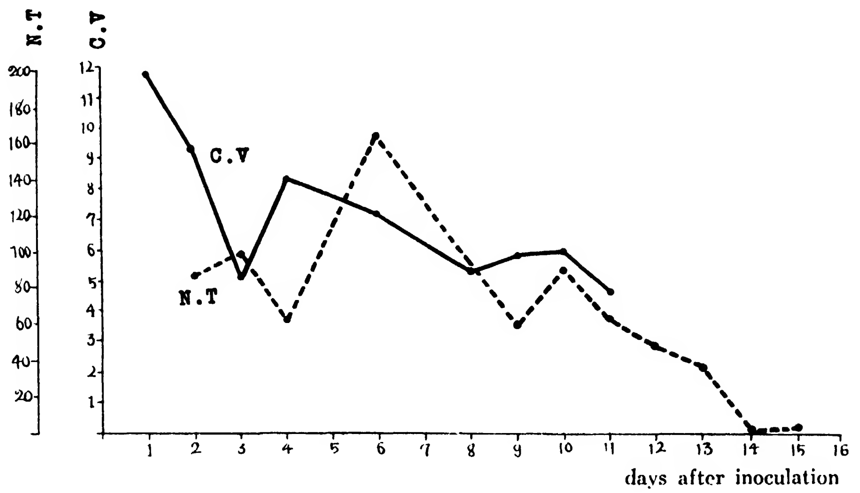
in which M is the mean, n is the number of individuals and x the magnitude of the measurements, not their deviation.

Table XXVI. Mean, standard deviation and coefficient of variation for the total length, and the number of trypanosomes per 50 fields in the course of infection; *T. conorhini* and mouse 136

Day	1	2	3	4	6	8	9	10	11
Number of individuals measured	100	100	100	100	100	100	50	50	50
Mean length	28.061	45.73	53 74	53.05	49.067	50.36	47.01	46.16	49.14
Standard deviation	3.3109	4.2367	2.7635	4.4167	3.4815	2 6625	2.7092	2.7452	2.2807
Coefficient of variation	11.7989	9.3645	5.1423	8.325	7.095	5.287	5.763	5.9458	4.6406
Number of trypanosomes per 50 fields of thick smear		85	100	62	165		60	91	63

As may be seen from the table, coefficient of length variation (C. V.) on the first day of infection was more than 11, on the second day 9.2, and then it sank to under 9 or 6. These figures seem to show that more or less reproduction occurred during the first few days of infection. Further, the generally greater number of trypanosomes on the second than on the first day, and the greater length variation on the first few days than later, seem to point in the same direction. It is, however, possible that this variation in length at an early stage may depend on the size variation in the inoculated material and on the difference in subsequent growth. If this view be correct, then the length variation and the high C. V. at the early stage of infection may be due

to other factors than reproduction. Furthermore, the difference in the number of parasites on the first and the following days as seen under the microscope



Text-fig 5. Graph of coefficient of variation (C. V) for the total length and the number of trypanosomes (N. T) per 50 microscopic fields, during the whole infection course, *T. conorhini* and mouse No. 136.

may have been due to the small size and delicate condition of the trypanosomes on the first day, so that they do not stain well and are easy to overlook in thick smears, whereas they stain better later on and easy to detect. I think it highly probable that the comparatively high value of C. V. at an early stage depends on the size variation of the inoculated form and not on the variation due to division. It is therefore very important to bear in mind that higher C. V. taken alone does not always indicate more active reproduction, but that it must be supplemented by other factors, such as morphological features etc., especially where, as in this case, infection has been effected from insects and the value of C. V. is comparatively high only at an early stage.

iii) Result of sub-inoculation. As already noted, the first sub-inoculation, at whatever stage of infection it may be done, gave entirely similar results, the trypanosomes appearing very slightly in the blood, so that further sub-inoculation was always impracticable. Taliaferro and others have found in *T. lewisi* that sub-inoculation did not give a typical infection course when performed after the production of the reproduction-inhibiting substance, but that a typical infection is obtained when the trypanosomes are treated with normal rat serum. In my own case, however, the result of the first sub-inoculation was always very slight at whatever stage of infection the blood for the sub-inoculation was drawn out. I am therefore of opinion that the mouse possesses, at least in some degree, a natural immunity to this trypanosome. The fact that primary inoculations with small doses of infective forms give almost negative results is in favour of this opinion.

iv) Result of splenectomy. As already mentioned, splenectomy does not increase the reproductive activity of this trypanosome, this indicating that the spleen does not take part in the production of whatever natural immunity the host may have.

v) Conclusion. From the above, it seems that, although *T. conorhini* appears to multiply temporarily at an early stage of infection, there is no positive evidence for the occurrence of reproduction; the evidences from C. V. and the numerical prevalence of the parasites in the blood admitting of another interpretation. I therefore believe that the mouse blood contains a priori a powerful substance inhibiting the reproduction of this trypanosome and its action increases as infection proceeds further, so that the multiplication of the parasites does not occur, at least so actively, at an early as well as at a later stage.

2. Trypanolysin or Destructive Resistance

For the natural disappearance of non-pathogenic trypanosomes from the blood of the host, two explanations have been pointed out by Taliaferro with reference to *T. lewisi*.

i) Initial inhibition of reproduction supplemented by non-specific phagocytosis by the reticulo-endothelial system.

ii) Action of specific trypanocidal anti-body.

Laveran and Mesnil (1901) are of opinion that phagocytosis is the chief if not the sole factor both in bringing infection to an end and in bringing about recovery, while Manteufel (1909) thinks that lysin is an important factor in highly immune animals, although phagocytosis may play a subordinate rôle. Taliaferro (1924) looks upon specific trypanolysin as the active agent, and Coventry (1930) holds the view that the serum is trypanocidal agent and that phagocytosis is not the sole and probably not the most important factor. In the case before us it is certain that immunity is produced in the course of infection, bringing about the gradual diminution and final disappearance of the parasites.

i) Trypanolytic action viewed numerically. As previously noted, in *T. conorhini* the number of parasites present in the blood is not, as a rule, subject to much variation in the course of infection, although it seems to increase at an early stage when certain method is adopted. It is notable, however, that the number suddenly diminishes 1–3 days or often 1 week before their complete disappearance. From this we may infer that the lytic substance is produced first gradually but suddenly increases at a late stage, destroying all the remaining parasites. This lytic substance is probably present in small quantity even at an early stage, since degenerating examples have been met with on the first day of infection. From this I conclude that the lytic substance must be present a priori, since its presence on the first day of infection can not be attributed to any antigen.

As to when the lytic property mentioned above becomes fatal, it appears

to depend on the grade of infection. That in heavy infections the parasites continue to appear for 12.8 days on the average in contrast to 19–29.1 days in slight or moderate infections, is probably due to the fact that in heavy infections the death of greater numbers of trypanosomes, which act as antigen, results in the production of more antibody than in slight infections, so that in the former the parasites disappear more quickly than in the latter. And in the production of the lytic substance, the death of the parasites other than the metacyclic forms, contained in the original inoculation may also take part.

ii) Process of trypanolysis. In examples subjected to lysis, the cytoplasma stains very badly and becomes granular or sometimes vacuolated. The peculiar pot-shaped structure in front of the parabasal body often becomes invisible. The lytic process generally begins on the side of the body opposite the undulating membrane, which later becomes detached from the axoneme; the nucleus is often extruded from the body, although it retains its affinity for stains while remaining in the body, so that enucleated examples are often met with. The axoneme stains well even when the body proper has been almost or entirely destroyed, and the blepharoplast often lies near its termination. Free axonemes are frequently found and their number may increase with the progress of infection.

3. Discussion and Conclusion of this Chapter

As Taliaferro (1922) has pointed out, the number of trypanosomes per cmm of blood is equal to the number produced by reproduction minus the number destroyed.

As noted already, in *T. conorhini* the number of parasites appears to increase at an early stage of infection, and the C. V. also points in the same direction. There are, however, findings which can not be reconciled with this view. In the first place division has never been met with, and the body length becomes constant at least after six days of infection, indicating that during this time reproduction is not continuous and is entirely negligible. Furthermore, the comparatively high C. V. at a very early stage of infection may be due to the fairly great length variations of the metacyclic forms inoculated and not to the active reproduction of the parasites. It appears to me quite probable that the apparent increase in the number of parasites at an early stage of infection may be due not to reproduction but to greater ease with which the parasites can be found out in smears on the second and third days than on the first day of infection, since the parasites have become more steady in form at that time. On the other hand it is to be noted that the less the infective forms inoculated, the smaller the number of parasites which appeared in the blood, sometimes not appearing at all; showing that multiplication is not active or does not take place. The conclusion I draw is then that reproduction-inhibiting substance exists a priori in the mouse in whatever its amount; in other words, that *T. conorhini* is in a very primitive condition as mammalian parasite and its adaptation to mammals still low.

In the further course of infection the numerical variation of the parasites does not show marked changes; which means that though multiplication is very inactive or nil, destruction is also not great. The resistance to parasites gradually increases, however, as the infection progresses and becomes very strong at a later stage, when the parasites diminish suddenly and entirely disappear in a few days. This power of resistance can remain for quite a long time and prevent re-infection, as will be mentioned in the next chapter; and since it is presumably produced by the destroyed trypanosomes, which act as antigen, the more parasites are killed, the more or the more rapidly the antibody is produced, shortening the duration of heavy infections. The spleen seems to be concerned more or less in the production of the antibody, since in splenectomized mice the infection lasts extraordinarily long. As, however, even in such cases the trypanosomes do not increase in number, it may be assumed that the spleen does not stand in intimate relation to the presence or production of reproduction-inhibiting substance.

b. Resistance to Re-Infection

In certain trypanosomes the power of resistance to re-infection is often retained for a long time, lasting at least for about 60 days in *T. lewisi*, and 6–7.5 months in *T. melophagium*. *T. conorhini* also presents a similar case.

1. Experiments on Recovered Normal Mice

Regardless of the duration of the primary infection, re-inoculations with the gut contents of *Triatoma* were performed on recovered mice at varying intervals, with the results shown in Table XXVII.

Table XXVII. Results of re-infection of recovered animals

No. of Experiment and date	Mouse	Dates of disappearance of tryp. and re-inoculation	Result
I (28/VIII, '29)	No. 57	26/VII–28/VIII	negative
	No. 73	control	moderate infection
II (26/X, '29)	No. 71	6/IX–26/X	negative
	No. 87	control	heavy infection
III (5/XXII, '29)	No. 84	5/XI–5/XII	negative
	No. 90	control	heavy infection
IV (20/II, '30)	No. 84	5/XI ('29)–20/II('30)	negative
	No. 72	8/IX('29)–20/II('30)	slight infection
	No. 93	control	slight infection
	No. 94	control	slight infection

In all the cases except No. 72, re-infection did not succeed, while all the controls showed positive results in varying degrees. The slight infection in No. 72 was due to the long interval between recovery and re-inoculation. It is evident from these results that the animals recovered from heavy infections have acquired absolute immunity to re-infection and retain it for a certain

period; very slight infections with interrupted appearance of the parasites in small numbers do not produce the immunity.

2. Retention of Resistance to Re-infection

As shown in Table XXVIII, re-inoculations performed within 107 days after the disappearance of the parasites all gave negative results and those performed after 165 days resulted in slight infections, whereas 301 days re-infection was as heavy as in the controls. We may therefore conclude that in *T. conorhini* the power of resistance to re-infection lasts for at least 100 days after recovery from the first infection.

Table XXVIII. Retention of the power of resistance to re-infection after recovery

Mouse	Days elapsed between disappearance of parasites and re-inoculation	Result of re-inoculation
No. 57	33 days	negative
No. 2	36 days	negative
No. 71	41 days	negative
No. 84	107 days	negative
No. 72	165 days	slight infection
No. 68	301 days	heavy infection

3. Effect of Splenectomy Performed in the Course of Infection on Resistance to Re-infection

As already stated, splenectomy seems to make infection more easy and can also prolong it conspicuously, showing that the acquisition of immunity is interfered with. The infection ceases, however, sooner or later, so that splenectomized mice also acquire immunity to infection; and the duration of this immunity was determined by re-inoculation. In a mouse (No. 2), in which the spleen was extirpated on the sixth day of infection and the infection lasted for 67 days, a re-inoculation 36 days after the disappearance of the parasites gave negative result, while in another (No. 74), in which the infection was very slight with interrupted appearance of the parasites and no increase in their number was seen after the operation, re-inoculation 52 days after the disappearance of the parasites gave positive result. I think the positive result obtained in mouse No. 74 is due not to splenectomy, but to the very slight primary infection which did not produce sufficient power of resistance.

4. Effect of Splenectomy on Completely Acquired Immunity

Re-inoculation was performed on mice which have acquired complete immunity by infection and on which splenectomy was carried out at varying intervals after the disappearance of the parasites, with the following results.

Table XXIX. Results of re-inoculation of mice splenectomized after disappearance of the parasites

No. of Exp.	Mouse	Days elapsed between disappearance of parasites and splenectomy	Days elapsed between disappearance of parasites and re-inoculation	Result
I	No. 71 (immune)	0	36	negative
	No. 73 (immune)	32	33	slight
	No. 87 (control)	—	-	heavy
II	No. 71 (immune)	83	84	negative
	No. 84 (immune)	0	30	negative
	No. 90 (control)	—	--	heavy
III	No. 82 (immune)	34	39	negative
	No. 91 (control)	—	—	moderate
IV	No. 83 (immune)	37	47	slight
	No. 92 (control)	—	—	moderate

The intervals between the disappearance of the parasites and re-inoculation varied from 84 days to 33–47 days, during which the power of resistance to re-infection, if completely acquired, has been proved to persist by the foregoing experiment. However, of two cases of re-inoculation on the day following splenectomy, one was negative and the other showed very slight infection. A re-inoculation 5 days after the operation gave negative result, whereas another performed 10 days after splenectomy yielded positive result. It therefore appears that splenectomy rapidly weakens the power of resistance acquired by infection bringing us back again to the intimate relation in which the spleen stands for the acquisition of destructive resistance.

Appendix. Resistance of Immunized Mice to Infection by *Trypanosoma cruzi*

The occurrence of immunological interaction of two different microorganisms may be quite rare, although in some double protozoan infections the action of one may be influenced by the antagonistic action of the other rather than by the acquisition of non-specific immunity. *T. conorhini* and *T. cruzi* present many points of biological similarity, so I have made some experiments of in-

Table XXX. Infection with *T. cruzi* of mice immunized to *T. conorhini*

Mouse	Material used for inoculation	Immune or not	1932 XI 10	11	12	13	14	15	16	17	18	19	20	21
No. 166	infected blood	immune	inoc.	+	±	+	+	−	−	−	+	+	+	++
No. 182	do	control	do	−	−	−	−	−	−	−	+	+	+	++
No. 152	gut content of insect	immune	do	−	−	−	−	−	−	−	−	−	+	+
No. 164	do	do	do	−	−	−	−	−	−	−	+	+	+	++
No. 181	do	control	do	−	−	−	−	−	−	−	+	+	+	+

oculating *T. cruzi* into mice immunized to *T. conorhini*, to see if the two species have any immunological character in common. The results were all negative; both the immunized mice and the controls were all infected by *T. cruzi*.

VI. Biology of *Trypanosoma conorhini* in the Insect Host

A. EXPERIMENTAL INFECTION OF TRIATOMA WITH MAMMALIAN BLOOD FORM

It is not known how infection goes on from insect to insect in nature. Infection by the suction of infected vertebrate must be one way, if such a host exists; so I carried out experiments on this line.

a. Susceptibility of Triatoma in Various Developmental Stages

Several lots of laboratory-born Triatoma in various developmental stages were allowed to bite infected mice, thereafter fed on normal rabbit blood, and dissected at intervals for the flagellates in the gut. 84 Triatoma examples, including nymphs of the I.–V. stages and adults, were used and 81 of them yielded positive results.

Table XXXI. Infection rates of each Triatoma group

Stage	Number of Triatoma used	Number of Triatoma infected
I. Nymph	5	5
II. Nymph	5	5
III. Nymph	3	3
IV. Nymph	14	12
V. Nymph	16	16
Adult	41	40
Total	84	81

The above table shows that all the nymphs of the I., II., III., and V. stages gave positive results, while 2 out of 14 nymphs in the IV. stage and 1 out of 41 adults remained uninfected. These negative results may be due to chance; possibly the trypanosomes introduced were not sufficient in number to effect infection. The high percentage of infection in the nymphs may be due to their voracity for blood. The flagellates developed equally well in the gut in all stages and both sexes of the insect into metacyclic trypanosomes.

Appendix. Infection Experiment in *Rhodnius prolixus*

Three examples of *Rhodnius prolixus*, originally from South America and bred in our Laboratory, were allowed to bite an infected mouse. They all became infected and all forms of the flagellate were present in the gut, as in Triatoma, and a mouse inoculated with the gut contents of one of them also

became infected. It is therefore certain that *Rhodnius prolixus* is a potential host of *T. conorhini.*

b. Infectivity of the Trypanosome at Various Infection Stages in Mammals

Since, as pointed out in another chapter, the trypanosomes introduced into the mouse grow as the infection progresses, some difference in their biological characters may be expected at different stages. On the other hand, the production of specific anti-body in the host blood may increase with the progress of infection, and consequently act on the trypanosomes more intensely at a later stage and diminish infectivity. At the same time the anti-body ingested by the insects with the flagellates might, in some way or other, influence the development of the latter in the insect gut. From these considerations, there seems the possibility to be that the infectivity of the trypanosome may differ according to the stage of infection, at which the experiment with Triatoma is conducted. To elucidate this point the following experiments were made.

Experiment I. One lot of 4 and another of 5 laboratory-born Triatoma were allowed to bite a mouse (No. 120) inoculated with the Triatoma gut contents containing large numbers of the parasites, respectively 24 hours and 9 days after the inoculation. On dissection after a certain lapse of time, all of the first lot and 4 of the second showed infection. It is therefore obvious that *T. conorhini* is equally infective for Triatoma as early as 24 hours after its introduction into the mammalian host as at a much later stage.

Experiment II. One lot of 2 and another of 3 Triatoma were allowed to bite a heavily infected mouse (No. 122), respectively 48 hours and 7 days after the commencement of infection. All of them became infected, but it is to be noted that examples affected by lysis are very frequently found about 7 days after the commencement of infection, although no difference has been detected in the development of the parasites in the two lots.

These two experiments show that if the parasites are present in sufficient number, the infectivity of *T. conorhini* for Triatoma does not differ at different stages in the mammalian host, even if the difference amounts to as much as between 24 hours and 7 or 9 days after inoculation.

B. INFECTION OF TRIATOMA BY MEANS OF OTHER THAN BITING INFECTED VERTEBRATES

In typical Trypanosoma, the transmitters generally become infected by attacking vertebrate hosts. The natural vertebrate host of *T. conorhini* is still unknown, and must be a rather uncommon species with little chance of being attacked by Triatoma. But the infection rate of the latter captured in nature is notably high. We have also to remember the fact already pointed out that this trypanosome species appears to be primitive in its adaptation to mammals and to retain many characteristics of insect parasites. These considerations

lead me to the conclusion that infection is probably effected in nature by direct transmission from insect to insect than by the intermediation of a vertebrate similarly as in *Herpetomonas*, *Crithidia* and *Leptomonas*, in which according to Wenyon infection spreads by means of encysted leishmania forms passed in the excreta, although definite encysted forms of any kind are sometimes never present. Further experiments are urgently needed to clear up this point.

a. Hereditary Infection

Although the possibility of hereditary infection by insect flagellates has been maintained by some authors, no conclusive evidence has been brought forward. Flu, Swingle, Porter etc. think that *Trypanosoma melophagium* of sheep is transmitted by ked eggs to the next generation, whereas Chatton and Delanoe, Cauchemez, Hoare etc. deny it on the ground of exact observations.

Examination of numerous offsprings hatched from the isolated eggs of heavily infected *Triatoma rubrofasciata* failed to bring out a single case of hereditary infection. If we remember that *T. conorhini* occurs only in the gut and in no other parts except fortuitously in the Malpighian tubes, this result is what we should expect a priori.

b. Direct Transmission from Insect to Insect

This may be the most probable mode of the spreading of infection as in other insect flagellates, and we have to consider two points in this connection.

1) The infective agent. It seems to be generally accepted that in those Trypanosomidae which parasitize insects only, infection is effected by encysted forms passed in the feces. For several of these flagellates, however, the presence of encysted forms has not been proved, and the same is true of *T. conorhini*.

The possibility of the spread of infection by other means seems to me possible. Patton (1910) and Becker (1923) pointed out that *Herpetomonas muscarum* is spread not only by cysts but also by precyst forms, and Adler (1928) from his experimental finding maintained the possibility of direct transmission of *Leishmania tropica* from sandfly to sandfly, so that we must also take into consideration forms other than cysts as agent of dissemination. In fact, in *Triatoma rubrofasciata* and *Trypanosoma conorhini*, some such mode of infection appears probable for several reasons. I think that any form can be infective if it enters the insect gut, and even where cysts are produced, some other developmental forms can be taken in by the insects with the cysts. In dry environment, however, the cysts have little chance of being swallowed by the insects, specially those with suctorial mouth parts like the Hemiptera; they can lick the feces in a liquid form but probably not in a dry state, so that even if cysts are produced, there is little chance for effective infection to take place. On the other hand, if there is sufficient moisture in the medium for the flagellates to survive, not only cysts but also other forms may be infective at least for a certain length of time. From the structure and habits of

Triatoma, I think this mode of their infection takes place in the case before us.

2) Way of infection. Whatever may be the infective form, infection may be effected somewhat as follows.

(i) Cannibalism. It is a common occurrence that one Triatoma attacks another which has had full meal of blood, especially younger nymphs often piercing older ones with the proboscis. *Rhodnius prolixus* bred in our Laboratory as well as other hemipterous insects have similar habit; and infection may take place in this way.

(ii) Fecal contamination. In Triatoma nests, the population consists of all developmental stages, and it is highly probable that fecal contamination goes on freely and disseminates the parasites. The following observations may shed some light on this point. A lot of first instar nymphs born in our Laboratory were placed in a tube containing infected adults, and fed almost daily with rabbit blood to promote defecation, so that the young nymphs may lick the liquid feces or be contaminated by them; but no positive result has been obtained so far. On the other hand, in a tube containing infected adults and young nymphs born from them, the latter showed infection only once during a long time; and since hereditary infection may be ruled out, I believe that the infection must be attributed to the ingestion of the feces of infected adults. It is therefore highly probable that the high percentage of natural infection among Triatoma is due to crowded life.

c. Survival of Various Forms outside the Insect Body

As a further test of the possibility of infection by means of forms other than cysts, following experiments on the survival of various forms of this flagellate outside the insect body were carried out.

Exp. I; Aug. 10, '31. Gut contents of infected Triatoma diluted with normal saline and kept at room temperature; 1 day after, the various forms were very active; 2 days after they were still motile; all degenerated on the following day.

Exp. II; Aug. 11, '31. Gut contents similarly treated gave about the same result. Inoculations into mice made before commencement of experiment and 1 day and 2 days respectively after it. In the first two, a slight infection was the result; the last mouse died the following day after inoculation without yielding definite result.

These experiments, not quite satisfactory as they are, appear to show that various forms can survive for at least 2 days outside the insect body at room temperature in summer and perhaps longer in cooler seasons.

According to Flu (1908) *Trypanosoma melophagium* of insects can be kept alive in normal saline for only 2 hours, and in serum for 8 hours, at room temperature. In an ice chest, however, it lived for 6 days. Porter (1909) found the same species alive for several hours at room temperature. Georgewitch (1910) could keep his flagellates alive in serum drops for several days. Hoare (1923) noted that the same flagellate lived for 7 days in normal saline at room

temperature, and 1 day at 30°C. These observations point to the possibility of infection through feces kept in a condition suitable for the viabilitv of the parasites.

C. DURATION OF INFECTION IN TRIATOMA

From the greedy habit of Triatoma throughout life and its susceptibility to *T. conorhini* at all developmental stages, we may infer that the metamorphosis can be gone through without the interruption of infection. This inference is confirmed by the following experiments.

Laboratory-born Triatoma in various stages of development were allowed to feed on infected mice and afterward given normal rabbit blood. They were killed after a certain number of days and examined for gut-trypanosomes, and

Table XXXII. Duration of infection in *Triatoma*

No. of Triat.	Stage when infected	Date of infection	Date of dissection	Stage when dissected	Finding at dissection	Duration of infection
1.	I. inst.	VIII. 10. '29	X 11, '29	IV. inst.	positive	62 days
2.	do	do	VII 19, '30	adult	do	343 days
3.	do	do	IX 25, '30	do	do	411 days
4.	do	do	XI 18, '30	do	do	465 days
5.	do	do	XII 15, '30	do	do	492 days
6.	II. inst.	VII. 12. '29	X 9, '29	IV. inst.	do	89 days
7.	do	do	do	do	do	89 days
8.	do	do	VII 29, '30	adult	do	375 days
9.	do	do	XI 18, '30	do	do	493 days
10.	do	do	XII 15, '30	do	do	520 days
11.	III. inst.	VIII. 2. '29	X 9, '29	IV. inst.	do	68 days
12.	do	do	VII 19, '30	adult	do	351 days
13.	do	do	XI 10, '30	do	do	465 days
14.	IV. inst.	XII. 9. '29	II 14, '30	do	do	67 days
15.	do	do	do	do	do	67 days
16.	do	do	do	do	do	67 days
17.	do	do	VII 17, '30	do	do	220 days
18.	do	do	IX 1, '30	do	do	266 days
19.	do	do	do	do	do	266 days
20.	do	do	XI 5, '30	do	do	331 days
21.	do	do	XI 18, '30	do	do	344 days
22.	V. inst.	VIII. 2. '29	X 9, '29	do	do	61 days
23.	do	do	IV 4, '30	do	do	238 days
24.	do	do	VI 27, '30	do	do	352 days

inst. = instar.

in certain cases mice were inoculated with the gut contents to ascertain the infectivity of the parasites. All the Triatoma examples which died a natural death had reached the adult stage.

From the results summarized in Table XXXII, it is clear that gut infection of Triatoma can continue without interruption for quite a long period covering both summer and winter till the completion of metamorphosis. In examples in the first instar, the infection lasted for 343–492 days, in those in the second instar for 375–520 days, in those in the third instar for 351–465 days, in those in the fourth instar for 220–344 days and in those in the fifth instar for 238–352 days. It has also been found that even after long continued infection of 425–520 days, the metacyclic trypanosome form is produced, as shown by successful inoculation with the gut contents of Triatomae.

D. INFLUENCE OF VARIOUS ANIMAL SERA UPON *T. CONORHINI*

As far as my experience goes, *Triat. rubrofasciata* attacks man and fowl in nature, and this has been confirmed by me with precipitation test of the gut contents. Under experimental conditions it also attacks rabbit, mouse, rat, guinea-pig, horse, cattle and pigeon. If these are attacked also in nature, it must be of special interest to study the influence of the blood of various animals upon the development and vitality of this flagellate in the insect gut. It will also help in the finding of the natural vertebrate host. I have performed several experiments in vivo as well as in vitro on this line.

a. Influence of Various Blood upon the Development of the Flagellates in the Insect Gut

Minchin, Gray and Tulloch (1906, 1907) maintained that goat blood may act *Trypanosoma grayi* in the gut of Glossina. Although no trypanosomes were found in about 500 *Glossina palpalis* freshly caught from Kemmi Island, Victoria Nyanza, and fed on a goat, they were present in the usual proportion (1.47%) in other Kemmi flies which were caught at the same time and fed on other experimental animals. They believed that the trypanocidal nature of goat blood was proved also in vitro, in as much as when a drop of goat serum was added to the fly's intestine teased out on a slide and containing *T. grayi* in large numbers, the trypanosomes were killed, while *T. gambiense* remained alive under similar treatment. According to Kleine and Taute (1911), in wild *G. palpalis* fed on a goat for about four weeks, the proportion of infection by *T. grayi* was 1.7%, as compared with 10% in unfed wild flies from the same locality (Ntuha Island, Victoria Nyanza), and the parasites from flies fed on a goat showed degeneration, as shown by their bodies packed with chromatin granules. Prates (1928) fed 400 wild *G. palpalis* on a goat and 250 on a monkey, and eighteen hours after 0.5% of the flies fed on a goat contained *T. grayi*, while those fed on a monkey contained none; the normal proportion of infection in flies from the same locality (Entebe Lake-shore) being 12–22%. He also tested the

effect of goat's serum upon *T. grayi* in vitro, but found that the flagellates retained normal activity for several hours. G. N. Hall communicated to Hoare (1928) that in 600 *G. palpalis* freshly caught on Buvuma Island, Lake Victoria, in 1927, the average infection by *T. grayi* was 5.3% ; that two batches of fifty flies each were fed every other day on a goat and an ox respectively for a period of thirty days, at the end of which the surviving flies (18 fed on a goat and 27 on an ox) were found on dissection contain no trypanosomes. Hoare (1928) obtained different results. He fed freshly caught *G. palpalis* for various lengths of time on goats, calves, and fowls every other day, and all the flies which died in the mean time were examined, with the result that *T. grayi* was found in 0–11.7% of the flies fed on goats, 2.5–3.8% of those fed on calves, and 4.2–11.1% of those fed on fowls. The percentage of natural infection of *G. palpalis* by *T. grayi* in the vicinity of Old Entebbe was found from examination of 694 freshly caught flies to be 9.6% on the average, it varied between 0 and 30.6% in individual batches. This wide fluctuation in percentage infection must be taken into account in considering the results of the feeding experiments mentioned above, since as pointed out by Hoare the discordant results of different several workers may be due to it, not to speak of the inefficiency in vivo of goat's blood upon *T. grayi.*

The above experiments which are the only ones on this line I could find in the literature, have stimulated me to perform similar experiments in vivo with *Triatoma rubrofasciata* and *Trypanosoma conorhini.*

Laboratory-born examples of Triatoma were allowed to bite infected mice and subsequently fed on certain animals after successful infection has been ascertained. One to several days after the last feeding they were examined for gut flagellates. Sometimes the gut contents were intraperitoneally injected into mice

(1) Rabbit blood. Long feeding of Triatoma on normal rabbit blood in our Laboratory for breeding purposes has proved that the development of the flagellates in the gut is not influenced thereby in any notable manner. Even 24 hours after the final feeding no remarkable change of the flagellates in the mid-gut has been noted.

(2) Mouse blood. An infected Triatoma was fed on a mouse 14 times during 26 days. On postmortem after certain days the gut showed moderate infection and the injection of its contents into a mouse (No. 105) proved the presence and infectivity of metacyclic trypanosome form in the gut. I have many other cases proving that the development and vitality of the flagellates in the gut are not influenced by feeding on the mouse.

(3) Guinea-pig blood. An infected Triatoma was fed on guinea-pig blood more than 20 times during 152 days, and moderate gut infection was proved after certain days, and injection of the contents into a mouse (No. 102) resulted in heavy infection.

(4) Horse blood. An infected Triatoma was fed on horse blood 24 times during 409 days and another 9 times during 63 days. The former was dissected 4 days and the latter 12 days after the final feeding; the gut was found

to be heavily infected in both, and two mice (Nos. 175, 182) inoculated with the gut contents of each showed slight infection, On the other hand, an infected Triatoma was fed on horse blood 14 times during 340 days, and on dissection the next day of the final feeding, the mid-gut showed only slight infection while the hind-gut was heavily infected. It seems that the horse blood had a fatal action upon the flagellates in the early period after feeding, when the blood was still indigested and may have retained its specificity; but even in this case it is certain that the flagellates in the mid-gut were not completely killed by the blood.

(5) Dairy cattle blood. An infected Triatoma was fed on dairy cattle blood 9 times during 160 days and dissected on the 12th day after the final feeding; the gut showed a heavy infection, and inoculation of a mouse with its contents resulted in a slight infection. Another infected Triatoma fed only once on cattle, was examined the next day, and the mid-gut showed as heavy an infection as the hind-gut.

(6) Native cattle blood. An infected Triatoma was fed only once on native cattle and dissected the next day. The mid-gut showed a slight infection, whereas the other parts were heavily infected, especially the rectum which contained a large number of metacyclic trypanosome form.

(7) Fowl blood. An infected Triatoma, which sucked rabbit blood several times, was fed on fowl blood 50 days after the final feeding on rabbit. and dissected after 48 hours. In mid-gut which contained already disintegrated blood corpuscles, the infection was moderate, but heavy in the other parts.

(8) Pigeon blood. An infected Triatoma was fed on pigeon 13 times during 198 days and dissected on the 174th day after the final feeding. The resulting infection was moderate, and a mouse (No. 103) inoculated with the gut contents, became slightly infected. Another infected Triatoma was fed 6 times during 62 days and dissected on the 8th day after the final feeding. The infection of mid-gut was comparatively slight, but that of the hind-gut was heavy.

The third infected *Triatoma*, fed on pigeon 11 times during 196 days, was dissected the next day after the final feeding. The mid-gut contained only small numbers of flagellates while the hind-gut and rectum showed heavy infection.

Summarizing the results, we see that none of the blood used in the experiments appears to have acted fatally on the gut flagellates, and heavy infections were observed in many cases. It is, however, interesting that in some cases in which pigeon or native cattle or horse blood was used, and the dissection done the next day after the final feeding, the mid-gut was very slightly, and the other parts were heavily infected, indicating perhaps that the blood of these animal species has an untoward action on the flagellates and either kills them or prevents their development for some time while the blood is still undigested. On the other hand, when dairy cattle was used and the dissection carried out the next day after the final feeding, the infection of the mid-gut did not show any notable difference from that of the other parts. We must

therefore conclude that fresh blood administered in vivo acts differently according to the animal species which supplied the blood, not to mention the possibility that the results may be due to causes other than the action of the blood. At any rate, my experiments have not confirmed the opinion already shown by Prates to be not generally applicable, of Minchin et al. and Hall in regard to *Trypanosoma grayi* and Glossina fed on goat blood.

b. Influence of Specific Immune Serum upon the Flagellates in the Insect Gut

As regards the above mentioned opinion of Minchin et al., Hoare (1928) has noted the possibility that the serum of the goat used by Minchin et al. in their experiments had exceptionally strong trypanolytic properties which may have developed in the course of some previous infection. Adams (1931), however, cites Duke's experiment that the feeding of infected Glossina on a previously immunized animal failed to dislodge the trypanosomes already present in the insect gut.

To see if the specific immune serum acts fatally upon the flagellates already present in the Triatoma gut, I fed an infected Triatoma on a previously immunized mouse seven times during 83 days and dissected it on the day of the last feeding. It was found to be heavily infected with various developmental forms. Furthermore, inoculation of a mouse with a part of the gut contents resulted in a slight infection. Specific immune serum therefore is not fatal to the insect-phase of this flagellate, when administered in vivo.

c. Action of Various Animal Sera in Vitro upon the Gut Flagellates

There have been reported some trustworthy positive cases of the fatal action of animal sera in vitro upon the insect-phase of certain flagellates. Johnson and Lloyd (1928) found that the fresh sera of some animals had strong lytic action on the developmental forms of *Trypanosoma congolense* and that fresh sheep serum was the least active of those tested. They found that drying sera on filter paper and storing for over a year caused loss of the trypanolytic power, and that in blood serum deactivated at 65°C. for thirty minutes and suitably diluted with Ponselle's medium, the trypanosomes multiplicated rapidly up to the eighth day. Adams (1931) noted that fresh sera of some mammals (man, baboon, monkey, goat, sheep, guinea-pig and rabbit), bird (fowl) and reptiles (crocodile and *Varanus*) rapidly kill the gut forms of *Trypanosoma rhodesiense* and *T. gambiense* recovered from laboratory infected *Glossina palpalis*, and that this action is destroyed by ammonia or heating at 56°C. for 20 minutes. Adams is of opinion that the trypanocidal action is to be attributed to the complement in the sera which is destroyed by heating or ammonia. It is of special interest that these same sera, not deactivated, exert no lytic action on the salivary gland forms of *T. rhodesiense* and *T. gambiense* in vitro. Why the infected flies are not sterilized by subsequent feeding of

Table XXXIII. Showing the period of survival in vitro of gut flagellates in saline containing fresh sera

Kind of serum	No. of experiment	Room temperature during experiment (C) Maximum	Minimum	Condition of flagellates after commencement of experiment: Within 1 hour	Over 1 hour
Human	I	29	25	....	active (2 hs, 5 hs, 24 hs, 48 hs, 72 hs), dead (96 hs)
Horse	I	29	25	....	active (2 hs, 5 hs, 24 hs, 48 hs) dead (72 hs)
	II	32.5	28	....	active (5 hs, 24 hs, 48 hs, 72 hs, 96 hs)
Water buffalo	I	31	27	....	motile (2 hs), non (24 hs)
	II	29.5	27	motile (20 m)............	motile (3 hs), non (24 hs)
	III	29	26	sluggish (10 m), non (15 m)	
	IV	26	23	sluggish (3 m), non (12 m)	
	V	32.5	28	....	non (5 hs)
Native cattle	I	29.5	27	non (20 m)	
	II	29	26	non (10 m)	
	III	26	23	sluggish (8 m), non (20 m)	
	IV	32.5	28	....	motile (5 hs, 24 hs, 48 hs), non (72 hs)
Dairy cattle	I	26	23	sluggish (10 m), dead (23 m)	
Hog	I	31	27	active (40 m)............	active (2 hs, 24 hs, 48 hs), dead (72 hs)
	II	32.5	28	....	active (5 hs, 24 hs), motile (48 hs) non (72 hs)
Dog	I	23	19	....	active (1 h, 24 hs, 48 hs, 72 hs), non (96 hs)
Rabbit	I	29	25	....	active (2 hs, 5 hs, 24 hs, 48 hs, 72 hs), dead (96 hs)
Albino rat	I	23	19	....	active (1 h, 24 hs, 48 hs, 72 hs), motile (96 hs), non (120 hs)
Fowl	I	31	27	non (40 m)	
	II	29.5	27	non (20 m)	
	III	29	26	sluggish (10 m), do (25 m)	
	IV	26	23	sluggish (5 m), dead (18 m)	
Pigeon	I	23	19	....	active (1 h, 24 hs, 48 hs) non (72 hs)
Control (saline water)	I	29	25	....	active (2 hs, 24 hs, 48 hs) motile (72 hs), non (96 hs)
	II	32.5	28	....	active (5 hs, 24 hs, 48 hs, 72 hs, 96 hs)
	III	31	27	active (50 m)............	active (2 hs, 24 hs, 48 hs, 72 hs, 96 hs)
	IV	29.5	27	active (20 m)............	active (3 hs, 24 hs)
	V	29	26	active (10 m, 25 m, 40 m)..	
	VI	26	23	active (12 m, 25 m)	
	VII	23	19	....	active (1 h, 24 hs, 48 hs, 72 hs) motile (96 hs, 120 hs)

m = minutes; h = hour; hs = hours.

normal complement-containing blood, Adams explains by assuming the presence of an anti-complementary substance in the gut. It has been shown that blood recovered from *G. palpalis* within ten minutes after feeding, is devoid of haemolytic complement. These interesting reports have led me to test the action of various sera on the gut flagellates in vitro.

A suspension of the parasites was made by teasing the infected guts in normal saline solution. 0.1–0.2 cc of this suspension was poured into each small glass tube, and to each was added 1 cc of the serum to be tested. The mixture was thoroughly shaken, kept at room temperature and examined at intervals. The sera used were usually prepared on the day of the experiment, but in some cases preserved in an ice box for 24-48 hours.

Table XXXIII shows that the eleven kinds of sera tested fall into two groups as regards their action upon the gut flagellates. a) The sera of man, horse, rabbit, hog, dog, albino rat and pigeon do not act fatally, so that the flagellates survived more than 48 hours and in some cases they showed active motion even after 72 hours, although they do not survive so long as the controls (in saline water) which remained alive for as long as 172 hours. b) The sera of water buffalo, native cattle, dairy cattle and fowl, especially the last, have conspicuous lytic action, so that the flagellates are destroyed, as a rule, in less than 20 minutes. This result was confirmed by repeated experiments, although strangely enough, in only one case out of a series of experiments with native cattle serum the trypanosomes survived in small numbers for 48 hours.

The various developmental forms of the trypanosome did not show differential susceptibility. Experiment with specific immune serum, though interesting, could not be carried out because of the difficulty of obtaining sufficient quantity of it from such a small animal as the mouse. Tests with deactivated sera of the second category are reserved for the future.

d. General Considerations on the Action of Various Animal Sera upon the Gut Flagellates

Experiments conducted in vivo as well as in vitro show that the action of animal sera upon the insect-phase of this trypanosome varies according to the condition and kind of sera. In the experiments in vivo with the sera of eight animal species, there was no case of complete suppression of infection, although when fowl, pigeon, native cattle and horse were used, the infection of the mid-gut on the next day after the final feeding was very slight in contrast to the heavy infection of other parts of the gut. We can not, however, attribute this result with certainty to the fatal action of these sera, because the slight infection of the mid-gut may be the result of a long failure of food, and even on the next day after feeding the flagellates are still not so numerous. Similarly, specific immune serum had no action upon the gut flagellates.

Of greater interest are the results obtained in vitro with the sera of water buffalo, native cattle, dairy cattle and fowl, which had marked lytic action. The slight infection observed in vivo in the Triatoma fed on native cattle or

fowl is probably due to this action. This granted, we must, however, remember that, as Adams (1931) has pointed out in Glossina, the blood may lose its lytic property by digestion or neutralization by an anti-complement possibly present in the gut. Duke, as cited by Adams, noted that Glossina infected by a trypanosome species can not be de-infected by subsequent feeds on blood of animals themselves naturally immune to the trypanosome. Thus, it seems certain that the ingested blood, whatever its property may be, is after ingestion deprived of its trypanolytic properties, and I think with Adams that in no other way can the failure of feeds to sterilize the insects be explained.

E. CONSIDERATIONS ON THE FACTORS INFLUENCING THE DEVELOPMENT OF METACYCLIC TRYPANOSOME FORM

In some Triatoma examples captured in nature, the metacyclic trypanosome form is found in enormous numbers, while in others it occurs only in small numbers or not at all. Consequently inoculations with the gut contents of Triatoma from the field yield very variable results, evidently corresponding to the number of metacyclic trypanosome form contained in the material used. I suppose that the appearance of this form is regulated by certain factors. In the first place, the age difference of the Triatoma and the duration of infection are negligible, as proved by my experiments previously cited, in which nymphs as well as adults could be similarly infected, and this form appeared in the gut as early as 5 days and as late as 465–520 days after the first infection. On the other hand, the following factors appear to me to need consideration. 1) The kind of blood ingested may have some influence upon the production of metacyclic form. But this seems to me improbable, since this form is produced whether the insects are fed on the blood of rabbit, mouse, rat, guinea-pig, horse, dairy cattle, native cattle or pigeon, though in the mouse the infection showed different degrees of intensity, which may be due to the numerical difference of the metacyclic form present in the insect gut and there is no cogent ground for thinking that the difference in the intensity of infection was due to the difference of ingested blood. 2) The frequency of blood ingestion. As will be noted in the next chapter, the resulting infection was often slight, even when the animals were inoculated with Triatoma gut contents, after feeding the insect 4–26 times on mouse, 14 times on rat, 26 times on guinea-pig, or more than 15 times on rabbit or pigeon. On the other hand, freshly caught Triatoma examples harboured enormous numbers of metacyclic forms in the gut. I think it improbable that the production of these forms is stimulated by repeated feedings, but rather probable that they are more actively produced during fasting, although proof is lacking on this point. 3) Temperature. A number of Triatoma examples were kept at room temperature for one week after infection, and then some of them were transferred to an ice box (10°–15°C), while the rest were left as before. All of them were allowed to bite normal rabbit every 5 days, whether they want to or not, and dissected after 41 or 43 days. The gut was infected and inoculations of mice

with the gut contents gave positive results for both lots, and the resulting infection was somewhat heavier when the insects kept in the ice box were employed. The different temperature conditions employed in this experiment did not prevent the production of metacyclic trypanosomes, although further research is needed. The insects could not continue to live at temperatures of about 0°C. or 37°C, making experiments under these conditions impossible. For comparison, the results of infection experiments in different months are given in Table XXXIV.

Table XXXIV. Mice infection by inoculation with gut contents, according to months

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Numb. of experiments	3	3	2	3	10	8	13	18	2	17	6	8
Numb. of positive cases	1	2	2	2	8	6	13	16	2	14	6	8

There is no notable difference in infection rates in different months. As may be seen from the next table, also the intensity of infection does not differ markedly according to months; heavy infections occurring in May — October as well as in December, and slight infections in each month. So far, no proof of the influence of temperature upon the development of metacyclic trypanosome form, or upon their infectivity and number has been found, although many points regarding this question remain yet to be cleared up.

Table XXXV. Intensity of infection in different months

Month		Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Numb. of infection in different degree	heavy				4		1			3		1
	moderate		1		1		1	5	3			3
	slight	3	1		1	2	2		1	9	2	4

My attempts to find out the factors which control the production of metacyclic trypanosome form in the insect gut have been a failure.

F. PROBLEM OF BLOOD ADAPTATION OF METACYCLIC TRYPANOSOME FORM, WITH SHORT DISCUSSION ON THE POSITIONAL LABILITY OF THE GENUS *HERPETOMONAS*

The trypanosomes which are at present established in the blood of certain vertebrates, must have gone through many steps of adaptation to blood parasitism. In this line, the trypanocidal property of normal human serum, first discovered by Laveran (1902) and recently re-investigated and newly discussed by several authors, is of interest. According to certain workers, *Trypanosoma gambiense* retains its resistivity to human serum for a very long time of passage through animals, whereas *T. rhodesiense*, the another causative agent of human sleeping sickness, loses its resistivity in some months under the same condition.

T. brucei, a parasite of domestic animals, and regarded by many authors to be specifically identical with *T. rhodesiense*, which is the human strain of *T. brucei*, is non-pathogenic to man and reacts to human serum. Recently Yorke, Adams and Murgatroyd (1930) expressed the opinion that the source of *T. gambiense* and *T. rhodesiense*, both pathogenic to man, is *T. brucei* having its natural reservoir in the game. They explain the matter as follows. The game trypanosome is not pathogenic to normal man because of the protective trypanocidal action of his blood. Under certain conditions (pathological and dietetic), however, this trypanocidal substance disappears and the man becomes susceptible to infection by *T. brucei*, which then develops in him into *rhodesiense*. These infections are seen typically in *G. morsitans* regions where the chief food supply of the fly is game or stock, but are of sporadic occurrence and unlikely to assume the form of considerable epidemic. They believe also that *gambiense* infections likewise originated in the same manner, but in *G. palpalis* regions, where the contact between man and fly is more intimate than in *morsitans* regions, there was a correspondingly greater chance of man to man infection. Prolonged man-Glossina-man passage has produced the modifications of the parasite which have resulted in the characters of *T. gambiense*, the most striking of which is its 'fixed' resistance to the trypanocidal action of human serum. If this view is correct, then *T. rhodesiense* and *T. gambiense* are good examples of well-established adaptation to a new host. It may be assumed that all the trypanosomes known at present have passed through several stages of adaptation to their hosts, and there are actually several trypanosomes which show different degrees of adaptation to vertebrate blood. The first step towards such adaptation must be the acquisition of resistivity to the destructive substance originally present in the host blood, and such an acquisition will make the multiplication of the parasites possible, while further increase of resistivity will make them pathogenic. I think that the first step in this supposed process is taken by the metacyclic trypanosome form produced in the invertebrate host, and in this respect, *T. conorhini*, as yet imperfectly adapted to vertebrate host, seems to offer an interesting material.

This process of adaptation of the metacyclic trypanosome form must be quite complicated, but it is easy to see that repeated contacts with certain vertebrate blood is a necessary initial condition; I therefore undertook a series of experiments of habituating the metacyclic form of *T. conorhini* to certain vertebrate blood, in order to see if they can thereby be made to show some difference, e. g. in the power of multiplication, from the control.

Before going into an account of my experiments, I must examine the form parasitizing the Triatoma captured in nature. As noted previously, it is a very common occurrence that the metacyclic trypanosome form is found in varying numbers in the gut or feces of the insects which have never been fed on any animal during their stay in the laboratory; and inoculations of mice with their gut contents almost always gave positive results, in proportion to the number of infective form present in the gut, although they did not increase notably in number in the course of infection. The question before us is, what change

is brought about in infectivity and multiplication, when the insect host is repeatedly fed on certain animals?

Table XXXVI. Results of inoculation of mice with the gut contents of Triatoma fed repeatedly on mouse

No. of mouse inoculated	No. of Triatoma examples used	Number of feedings given to Triatoma	Condition of infection		
			Incubation	Duration of infection	Intensity of infection
86	10	more than 23	1 day	19 days	slight
74	20	more than 19	8 days	7 days	very slight
75	do	do	negative		
91	13	26	1 day	more than 9 days	moderate
57	49 59 64	4 12 11	2 days	23 days	slight
58	do	do	3 days	22 days	slight*
63	62 66 72	21 10 8	1 day	3 days. died	moderate
65	do	do	1 day	4 days. died	slight
66	do	do	1 day	more than 17 days	slight
69	67	16	2 days	16 days. died	moderate
70	do	do	1 day	4 days. died	moderate

* splenectomized.

a. Inoculation of the Same Animal Species as that on which the Insect Host was repeatedly Fed

Experiments under this heading were performed with mouse and rat.

i) Mouse. As seen from Table XXXVI, inoculation of mice with the gut contents of experimentally infected Triatoma examples fed on mouse 4–26 times, resulted in heavy as well as light infection, and the parasites hardly showed any tendency to multiply later. In four cases the mice died from acute or subacute infection, and in one case a certain tendency of the parasites to multiply could be seen. It is, however, doubtful whether special weight should be laid on these cases, since the same tendency was sometimes observed in other cases where inoculation was made with the gut contents of Triatoma given much less feedings. I believe it to be certain that the difference in the intensity of infection in these cases was due to the different number of metacyclic trypanosome form contained in the gut materials.

ii) Rat. An experimentally infected Triatoma was fed on rat 14 times during 30 days and on the fourth day after the final feeding, inoculation with its gut contents was made on a rat and a mouse. The results are shown in Table XXXVII.

Table XXXVII. Infection course in rat No. 4 and mouse No. 88. Oct. 1929

Date		X 30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Numb. of parasites per 100 fields	rat	inoc.	2	?	?	0	0	0	2	3	3	?	1	0	1	0	1	1	0	0
	mouse	inoc.	53	70	79	62	68	33	51	51	52	?	47	3	0	0	0	0	0	0

What is worth noting in these experiments is that the rat at first gave positive result, although the infection was very light in contrast to the heavy infection of the control mouse. This was my first success with the rat, and one may be tempted to attribute it to the adaptation acquired by *T. conorhini* through repeated feedings on rats; but I think it more probable that it was due rather to the number of metacyclic trypanosome form introduced by inoculation. If the number was small, the parasites may easily escape detection in the peripheral blood of even susceptible animals, because this trypanosome species multiplies in the vertebrate host very little or not at all. The rat may be susceptible to this trypanosome, but owing to the size of its body, the trypanosomes must be largely scattered and difficult to detect in the blood stream, unless introduced in great numbers. This is my explanation of the different results obtained for the mouse and the rat, both inoculated with about the same dose of the same gut contents. I do not say that multiplication of the trypanosomes took place in the rat.

b. Inoculation of Different Animal Species from those on which the Insect Host was repeatedly Fed

Infected Triatoma examples were fed on rat, guinea-pig, rabbit, horse, dairy cattle, and pigeon, 14 times, 20–26 times, 15 times, 9–24 times, 9 times and 13–15 times respectively, and inoculations from their gut contents were separately made on mice. The results were positive in all cases, though the intensity of infection was various, and prove at least that the metacyclic trypanosomes which were repeatedly brought into contact with the blood of certain animal species, can establish themselves in an animal of a different species.

c. Discussion

My experiments show that repeated feedings of the insect host on the blood of certain animal species can not impart to the metacyclic trypanosome form greater adaptability or reproductive activity when introduced into animals of the same species. On the other hand, repeated feedings on certain animal species does not impair the infectivity of the trypanosome for different animal species. Although the experiments to impart increased adaptability to the trypanosome all gave negative results, the attempt should not be looked upon as hopeless, because a long period of time is evidently necessary for it.

As a matter of fact, we know some trypanosomes which are infective and pathogenic in varying degrees to vertebrate hosts, and they seem to suggest the long history of their present adaptation, and even in such typical mammalian parasites as *T. gambiense*, *T. rhodesiense* and *T. brucei*, the adaptability appears to be still alterable, the first two species losing their resistivity to human serum by long passage through animals. In a similar way, the adaptability of metacyclic trypanosome form of the insect gut to vertebrate host may be capable of undergoing alteration in the long run. Viewed from this angle, the classification of Trypanosomidae at present in vogue may need revision.

Wenyon (1926) noted that the genus *Herpetomonas* parasitizes exclusively invertebrates, but produces all four forms — leishmania, leptomonas, crithidia, and trypanosome — in its life cycle. But this last form needs further study, as it is questionable if in all *Herpetomonas* species it passes its whole life in invertebrate hosts. In my own opinion it may originally have been produced as the final product of the life cycle, stimulated by some such agency as, for example, repeated contact with vertebrate blood, but may be in the long run so altered as to be infective for vertebrates. Such an alteration would produce a *Trypanosoma*, *T. conorhini*, which is without doubt a member of *Trypanosoma* experimentally capable of infecting vertebrate blood, although the natural host is still unknown, and at the same time an insect parasite in several points. It may be such an example that has become adapted to vertebrates in comparatively recent time. The taxonomic position of *Herpetomonas* is therefore still uncertain, as far as Wenyon's definition of the genus is concerned.

VII. Summary and Conclusion

1) A species of flagellates, resembling in many points the insectan phase of *Trypanosoma cruzi* Chagas, occurs very commonly in the gut of *Triatoma rubrofasciata* in Formosa. Investigations and experiments conducted by the writer in 1928 — 1932 on its morphology and biology led to the conclusion that it can infect certain mammals, but is non-pathogenic and referable to *Trypanosoma conorhini* (Donovan).

2) In Taihoku the frequency of Triatoma infection is 61.8% on the average; 72.7% in adult females, 63.9% in adult males and 46.6% in nymphs. The percentage of infection for the years 1928 — 1932 ranges between 54.3 and 90. The monthly variations are not notable.

3) In the insect host, it occurs exclusively in the alimentary tract from the mid-gut to the rectum, and in no other part of the body except the Malpighian tubes, in which it was found only once.

4) The principal forms produced in the insectan body are crithidial, leishmania and metacyclic trypanosome forms, supplemented by pyri-, spindle-shaped and transitional forms. The size of the first two and the last varies considerably owing to division.

5) The trypanosomes of the mouse are transformed in the insect gut into

the crithidial form almost entirely after 24 hours. For some days the infection is confined to the mit-gut but reaches the anterior part of the hind-gut in 5 days at the latest, and the posterior part of the hind-gut and rectum in 2 days more. At the beginning of infection, the typical crithidial form is the prevailing one and the spindle-shaped form is occasionally found; later the crithidial forms of varying size are produced and various irregular forms increase and lead to the final appearance of the leishmania form. The metacyclic trypanosome form can be seen as early as 5 days after the infection and reaches the rectum after 9 days more at the latest. On the 10th day of infection there is no general rule in regard to the forms produced or their distribution in the gut. It is probable that the metacyclic trypanosome form can be produced in any part of the gut.

6) *T. conorhini* develops exclusively in the gut lumen and no haptomonad or intracellular form has been observed so far.

7) *T. conorhini* begins to appear in the feces of *Triat. rubrofasciata* as early as 13 days after the commencement of infection; in many cases, however, after 20 days or more.

8) Though *T. conorhini* can infect mammals, it retains on many points the character of insect parasites; the production of the leishmania form in addition to the metacyclic trypanosome form has probably an important significance. I am of opinion that the life cycle of this flagellate in the insect body proceeds in two different lines: one leading to the leishmania form (leishmania cycle) and the other to the metacyclic trypanosome form (trypanosome cycle). Sometimes, however, the metacyclic form appears to be transformed into the leishmania form. The two lines may again unite at a later stage and both produce the leishmania form.

9) Although the natural vertebrate host of *T. conorhini* is still unknown, it can develop to typical Trypanosoma when inoculated into mice and rats, but not in the pigeon.

10) The most striking characteristics of the mammalian form of *T. conorhini* is its extraordinarily elongated body with thread-like posterior part, and the presence of a pot-shaped structure just in front of the parabasal body.

11) The total length of the trypanosome body on the first day of infection in mammals is 28.1 μ on the average; the average maximum of 53.7 μ is reached on the 3rd or 4th day, after which it tends to become somewhat less, owing to the shortening of the free flagellum. The relative length of the anterior and posterior parts of the body is subject to change, the latter being longer at an early stage but shorter after the 4th day. The variation in length from day to day is not so marked as in *Trypanosoma lewisi* and the maximum length is always less than twice the minimum. On each day, almost all the individuals or at least about half of them have the modal length.

12) It is remarkable that no division has been observed,in the mammalian form of *T. conorhini*.

13) In the mammalian blood, *T. conorhini* occurs, so far as my researches go, in the lung, heart, liver and kidney as well as in

the peripheral vessels.

14) The insectan form of *T. conorhini* multiplies actively in normal agar containing rabbit blood. Subcultures have failed. In the cultures the same forms appear as in the insect gut, excepting the metacyclic trypanosome form. Cultures from the infected mammalian blood have not succeeded.

15) Infection of mice can be most easily effected by the intraperitoneal injection of the gut contents of infected Triatoma. Subcutaneous inoculation is not always successful. Attempts to infect mice by the insect bite have failed, but infection per os and through skin wounds succeeded. Therefore, percutaneous and peroral infections are probably the natural way of dissemination.

16) *T. conorhini* may appear in the peripheral blood as soon as 3 hours after the intraperitoneal injection of the gut contents, although in some cases the first appearance was as late as 8 days after. This difference in the incubation period seems to be attributable to the variable number of metacyclic trypanosome form present in the injected material. In oral infections the incubation period was 1 day and in percutaneous 11 days.

17) Under experimental conditions, the infection by *T. conorhini* lasts in normal mice for 1–36 days, correlated to the number of the trypanosomes appearing in the blood. Heavy infections last on the average for 12.8 days; light infections for 19.4 days.

18) The number of parasites in the peripheral blood is not subject to much variation, but depends upon the number introduced by the inoculation.

19) Similar peculiarity is also observed in young mice, contrary to the expectation that they may be less resistant.

20) Sub-inoculation of the mammalian form has not succeeded beyond the first, and even the first sub-inoculation resulted in very light infections.

21) In the mouse splenectomy furthers infection, but if it is performed before the appearance of the parasites in the blood, it has apparently no effect. On the other hand, if the operation is performed during the appearance of the parasites, it conspicuously prolongs the duration of infection, although the parasites do not increase in number. This may be due to the inhibition of the production of the destructive substance in the host.

22) In mice treated with human serum just after inoculation, the resulting infection was very light, whereas in the control it was always more steady or definite. If, however, the human serum was injected into mice 6–14 days after the appearance of the trypanosome in the blood, the infection course did not seem to have been so markedly altered as in infections with old-standing *Trypanosoma gambiense*. The injection into mice of various animal sera, such as those of the horse, water buffallo, native cattle, dairy cattle, hog, rabbit and fowl, just after inoculation, resulted in lighter infections than in the control. Whether this result is due to something analogous to the trypanocidal action of normal human serum on pathogenic trypanosomes, is not clear.

23) As to the resistivity developed in the mouse in the course of infection, it appears from various considerations that it possesses an a priori resistance to the multiplication of *T. conorhini*, which may increase as the infection

continues and the production of the destructive substance also increases during the infection course, becoming very strong at a late stage, owing perhaps to the antigenous property of the parasites killed, so that the more the parasites are killed, the more or the more rapidly the antibody is produced. As a matter of fact, heavy infections last for a rather short time.

The recovered animals have acquired absolute immunity or resistance against re-infection and retain it as long as 107 days, but it becomes subsequently weakened, so that 165 days after the disappearance of the parasites light re-infection is possible; and this diminution of resistivity is accelerated by splenectomy. After a certain duration of infection, however, complete immunity is the result, even if splenectomy is carried out.

24) Animals recovered from the infection of *T. conorhini* can be readily infected with *T. cruzi*, which seems to be biologically similar to the former.

25) Triatoma of all developmental stages becomes infected by *T. conorhini*, through ingestion of the blood of infected mouse. *Rhodnius prolixus* can also be infected.

26) The length of passage through the mammal host has no effect on the infectivity of *T. conorhini* for insects, these becoming infected similarly whether the blood is ingested as early as 24 hours after the inoculation or later. The only important factor is the presence of a sufficient number of parasites in the blood.

27) The natural vertebrate host of *T. conorhini*, which still remains to be found out, must be rather an animal with little chance of being attacked by the insect. But since the latter shows a high percentage of infection in nature, it is inferred that dissemination takes place from insect to insect by direct transmission, heredity playing no part in the process. The possible ways of infection are the mutual attack of the insects and fecal contamination due to crowded life. No cysts nor any resistant forms have been found in *T. conorhini*, and all forms produced in the life cycle are probably infective for the insect.

28) *T. conorhini* can survive outside of the insect body for at least 2 days at room temperature during the summer season. It seems probable that infection of the insect is due to contamination with feces containing such surviving forms.

29) Infected young Triatoma can complete metamorphosis without interruption of the infection, so that this may be of quite a long duration, lasting for 343–492 days in insects infected at the first instar, for 375-520 days in those infected at the second, 351–465 days in those infected at the third, 220-344 days in those infected at the fourth, and 238–352 days in those infected at the fifth instar.

30) Subsequent feedings on rabbit, mouse, guinea-pig, horse, dairy cattle, native cattle, fowl and pigeon, failed to dislodge *T. conorhini* already established in the Triatoma gut, there being no difference in this respect between susceptible and immune animals. This may be because the ingested blood, whatever may be its original property, undergoes alteration in the insect gut and loses its trypanolytic property. On the contrary, the sera of water buffalo, native

cattle, dairy cattle and fowl exhibited marked trypanolytic action in vitro.

31) As to the factors affecting the production of metacyclic trypanosome form in the insect gut, the age difference of the host and the duration of infection appear to be negligible, as also the animal species which furnish the blood as well as the frequency of the feedings. Temperature has also been found to produce no marked difference. So other efficient factors have to be found out.

32) Attempts to increase the infective power and multiplication of metacyclic trypanosome form by bringing them in repeated contact with the blood of certain animal species, have resulted in failure. For reasons given in the text, it should be possible to effect it in the long run, and the first step in this process must be the acquisition of resistivity to the action of the blood of the host. On the other hand, the metacyclic trypanosome form from Triatoma repeatedly fed on certain animal species does not lose its infectivity for other animal species; time is an important factor in this process of adaptation. The infectivity for vertebrates of the metacyclic trypanosomes produced in the insect gut must have been acquired in a long course of time. The taxonomic position of the genus *Herpetomonas* as defined by Wenyon, appears to me uncertain, until it has been proved beyond doubt that it never can parasitize vertebrates.

33) From the facts mentioned above, the trypanosome before us may present a primitive form which has become adapted to vertebrates in comparatively recent time.

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Explanation of Plates

All the figures were drawn with a camera lucida.

Plate II

a. Photograph illustrating the method of breeding and feeding of Triatoma in the laboratory.
b. *Triatoma rubrofasciata* (de Geer). Female.

Plate III

Trypanosoma from the blood of mouse. Giemsa stain in alkaline medium.

Figs. 1, 2. Immature trypanosomes on the first day of infection, in which the nuclei are kidney-shaped and the pot-like structures in front of the parabasal body is still unstained.

Figs. 3, 4. Immature trypanosomes on the first day of infection, in which the nuclei are oval in shape, although the pot-like structures are still unstained.

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Fig. 9. Mature trypanosome on the same day of infection.

Fig. 10. Mature trypanosome on the fourth day of infection.

Fig. 11. Mature trypanosome on the sixth day of infection.

Fig. 12. Mature trypanosome on the seventh day of infection.

Fig. 13. Mature trypanosome on the tenth day of infection.

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All the figures are from Giemsa-stained slides.

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Figs. 19–31. Large crithidial forms from the gut and rectum of Triatoma.

Fig. 32. Dividing form of large crithidia.

Fig. 33. Large crithidia with peculiar shape.

Plate V

All the specimens are from the alimentary tract of Triatoma and stained with Giemsa.
Figs. 34-44. Medium sized crithidial forms with slender body.
Figs. 45-51. Medium sized crithidial forms with broad body.
Figs. 52-55. Medium sized crithidial forms in division.
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Figs. 60-69. Small crithidial forms.

Plate VI

All the specimens are from the alimentary tract of Triatoma and stained with Giemsa.
Figs. 70-97. Transitional or irregular forms derived from crithidial forms of various sizes.

Plate VII

All the specimens are from the alimentary tract of Triatoma and stained with Giemsa.
Figs. 98-106. Pyriform crithidial forms, some of which are in division.
Figs. 107-110. Spindle-shaped crithidial forms of large size.
Figs. 111, 112. Spindle-shaped crithidial forms in division.
Figs. 113-118. Spindle-shaped crithidial forms of small size, which are attached in couple or aggregated or enclosed in a thin membranous capsule.
Figs. 119-123. Metacyclic trypanosome forms of slender and sickle-like shape.
Figs. 124-132. Metacyclic trypanosome forms of shortened and rounded shape.
Figs. 133, 134. Leishmania forms with flagellum.
Figs. 135-140. Leishmania forms of large or medium size.
Figs. 141-143. Leishmania forms of small size.
Figs. 144-147. Large leishmania forms affected by division.
Figs. 148, 149. Degenerated leishmania forms.

Plate VIII

All the specimens have been fixed with Schaudinn's fluid and stained with iron hematoxylin.
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Figs. 153-158. Crithidial forms from the gut of Triatoma.
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Plate IX

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Fig. 172. Photograph of metacyclic trypanosome form from rectum of Triatoma. Giemsa stain.
Fig. 173. Photograph of living spindle-shaped forms from the gut of Triatoma.
Fig. 174. Photograph of living crithidial forms from the gut of Triatoma.

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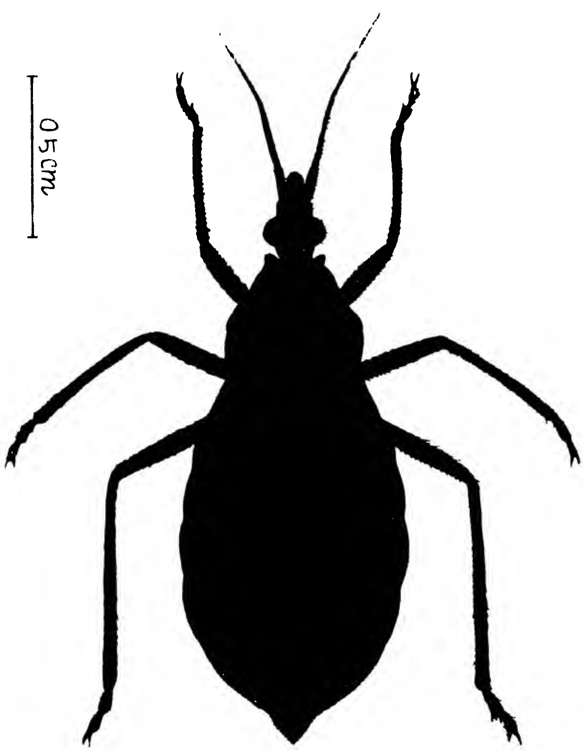

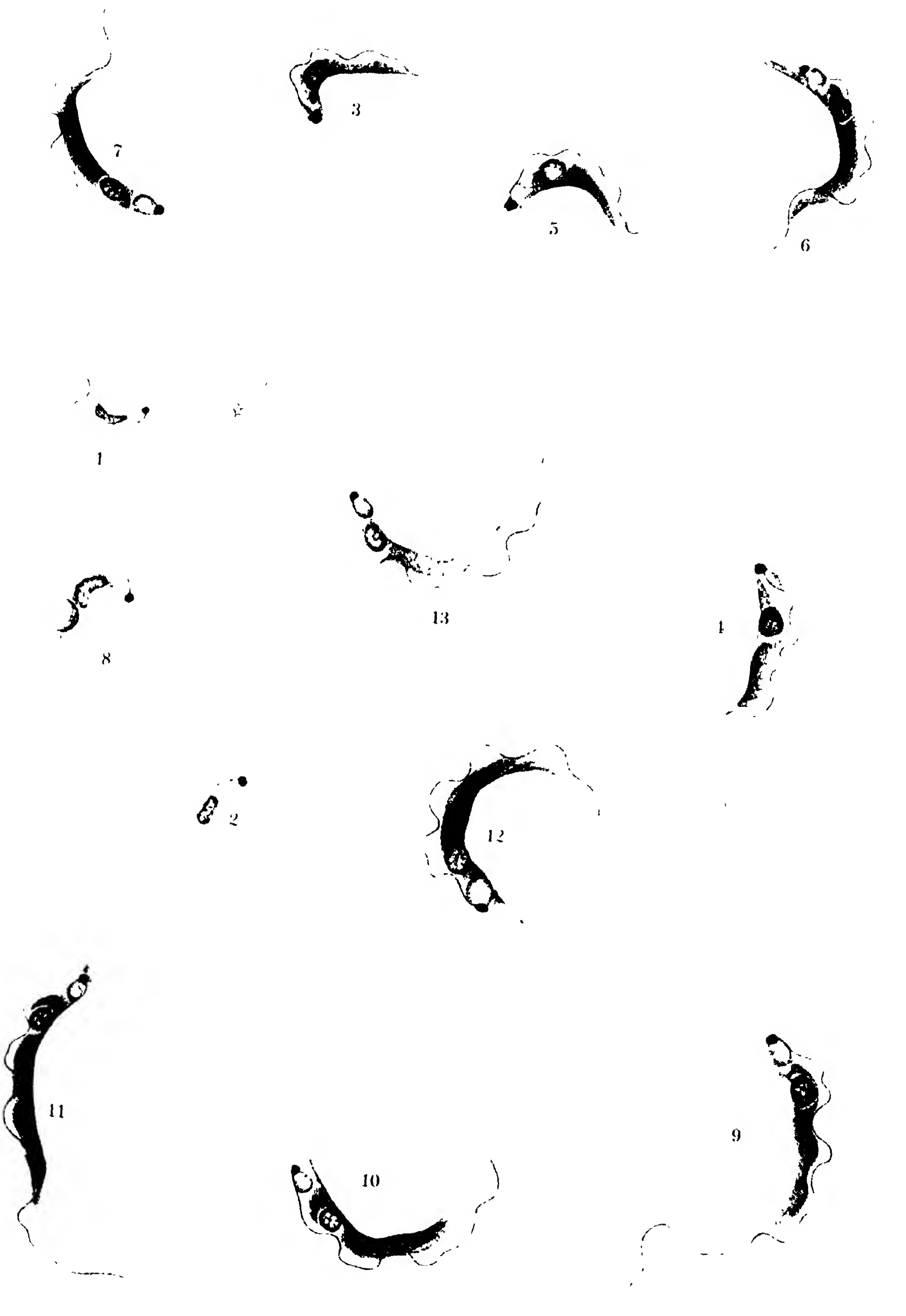
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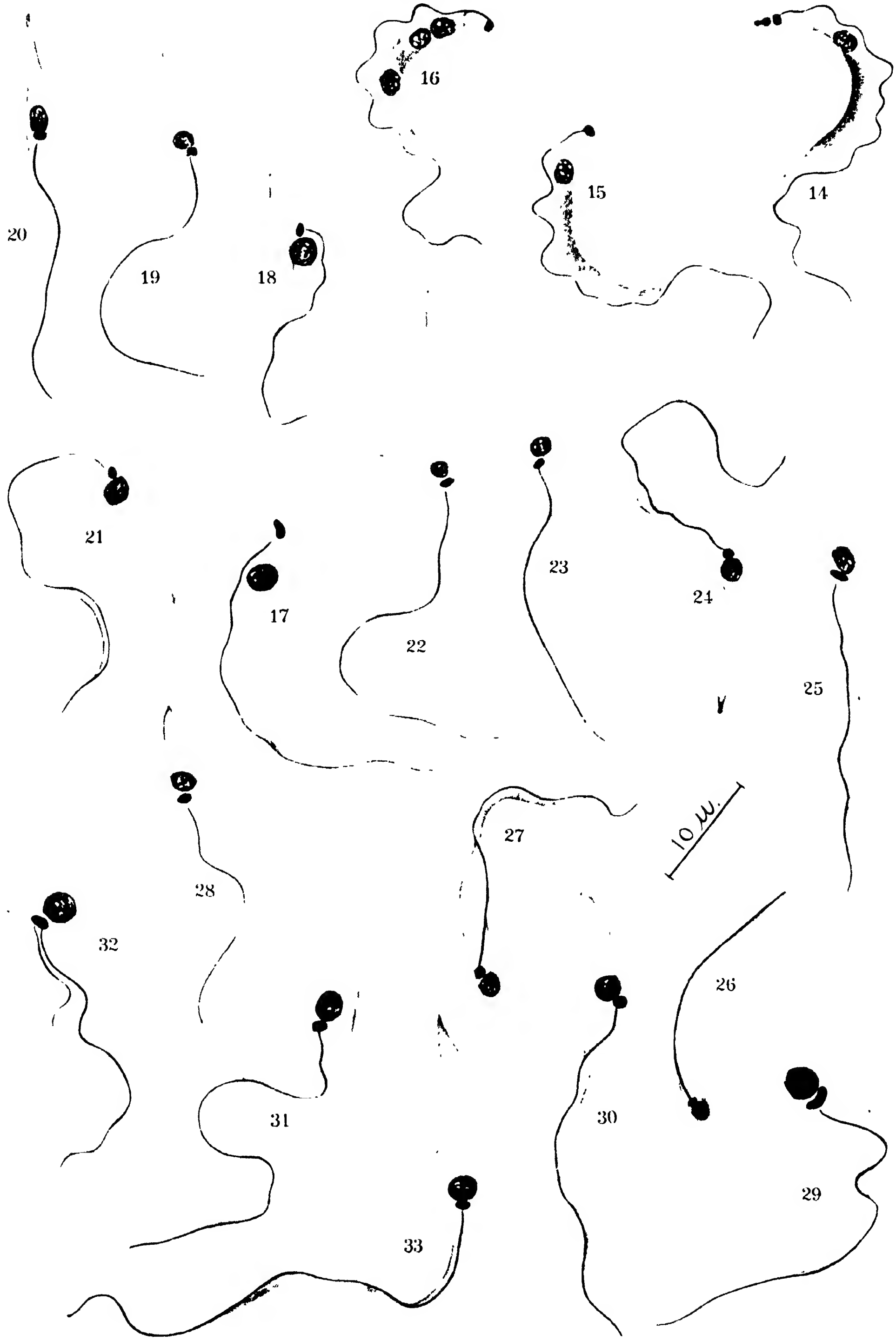
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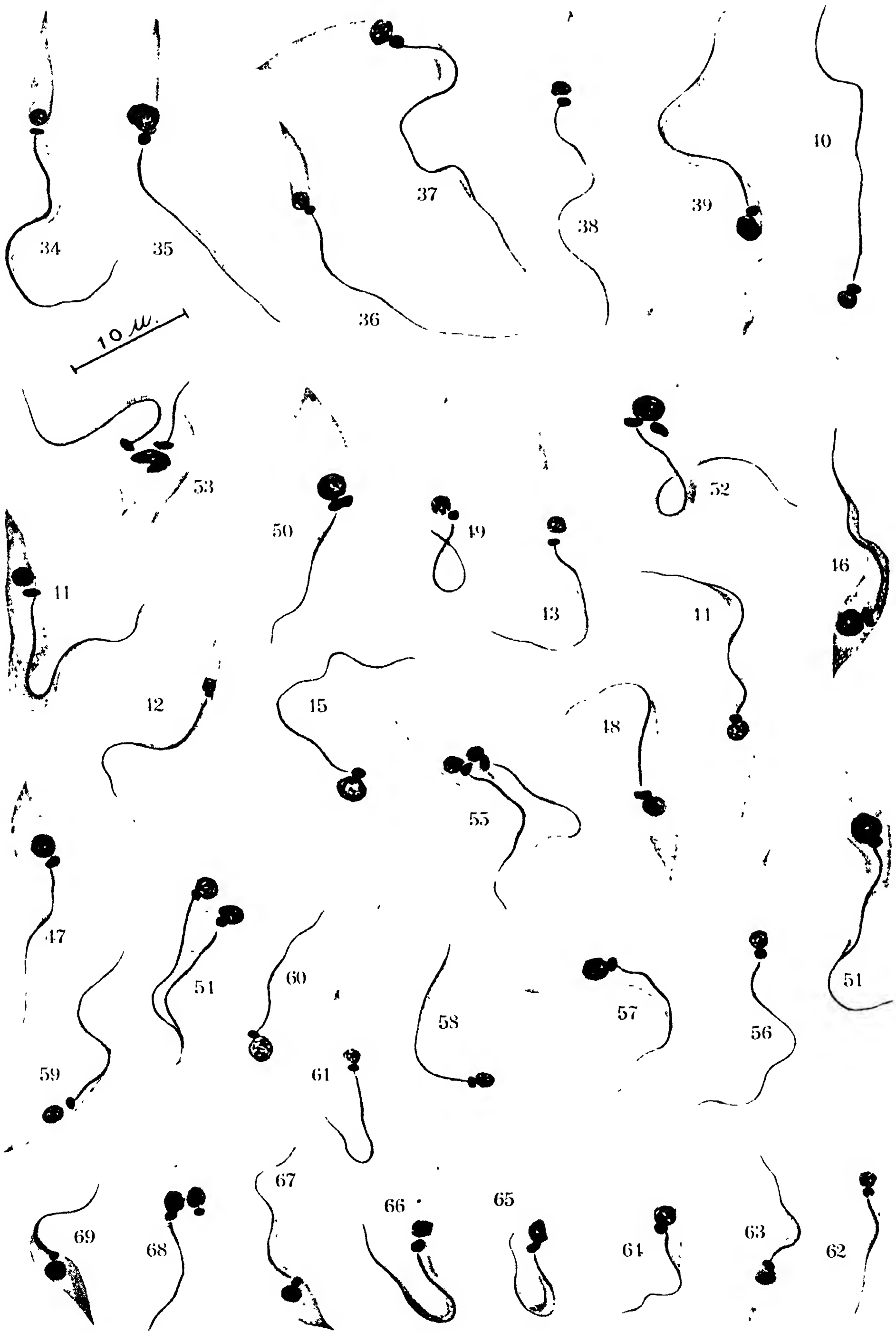

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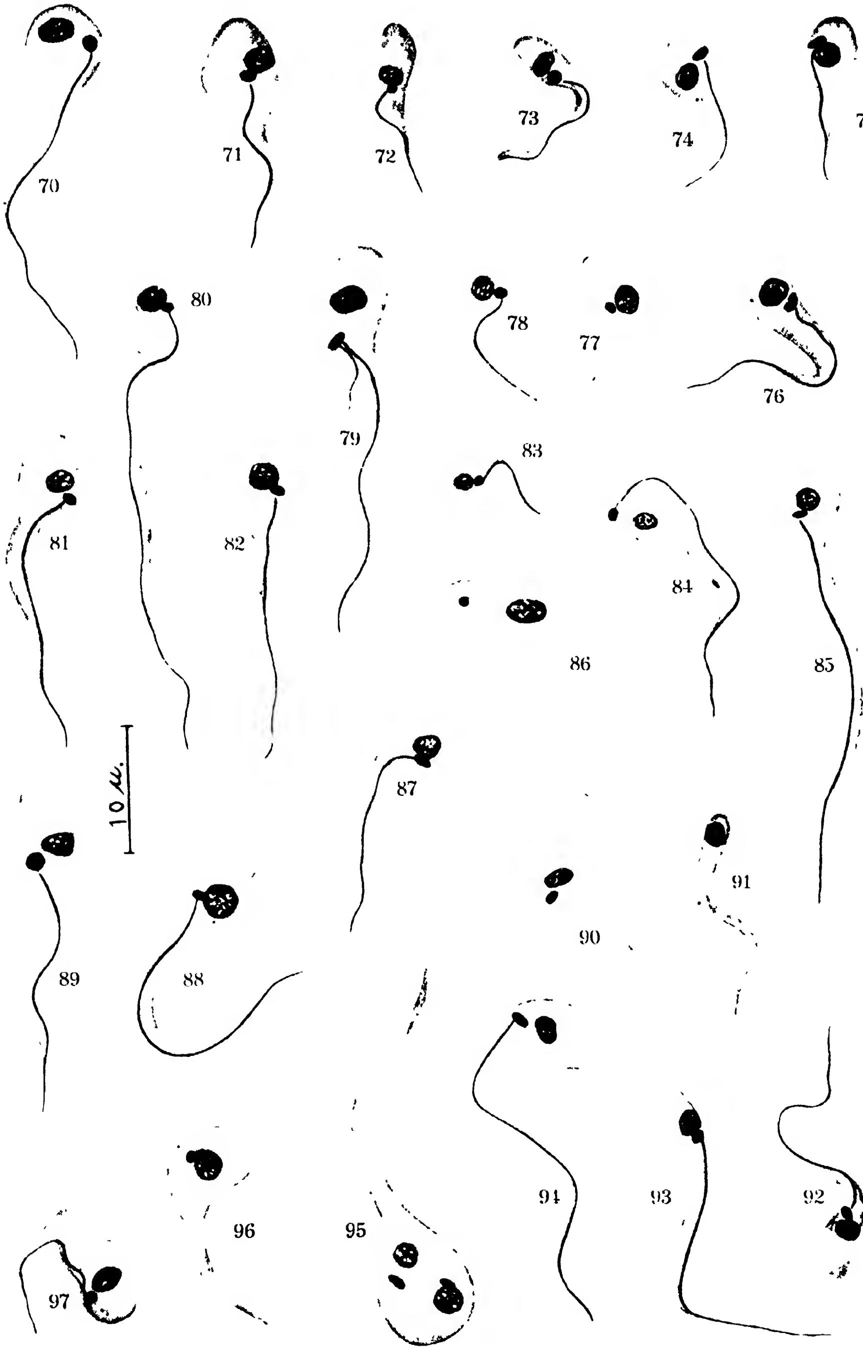
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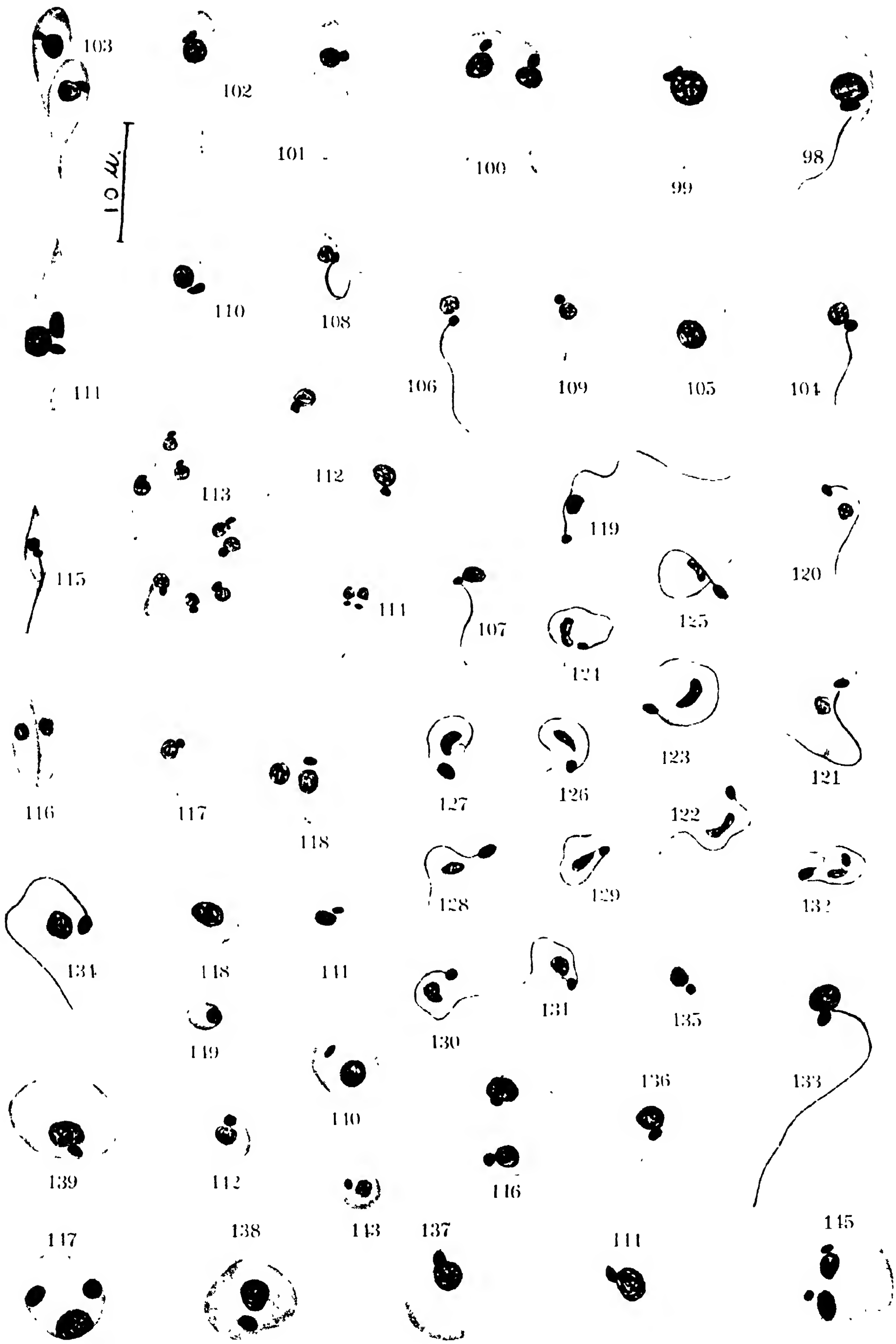
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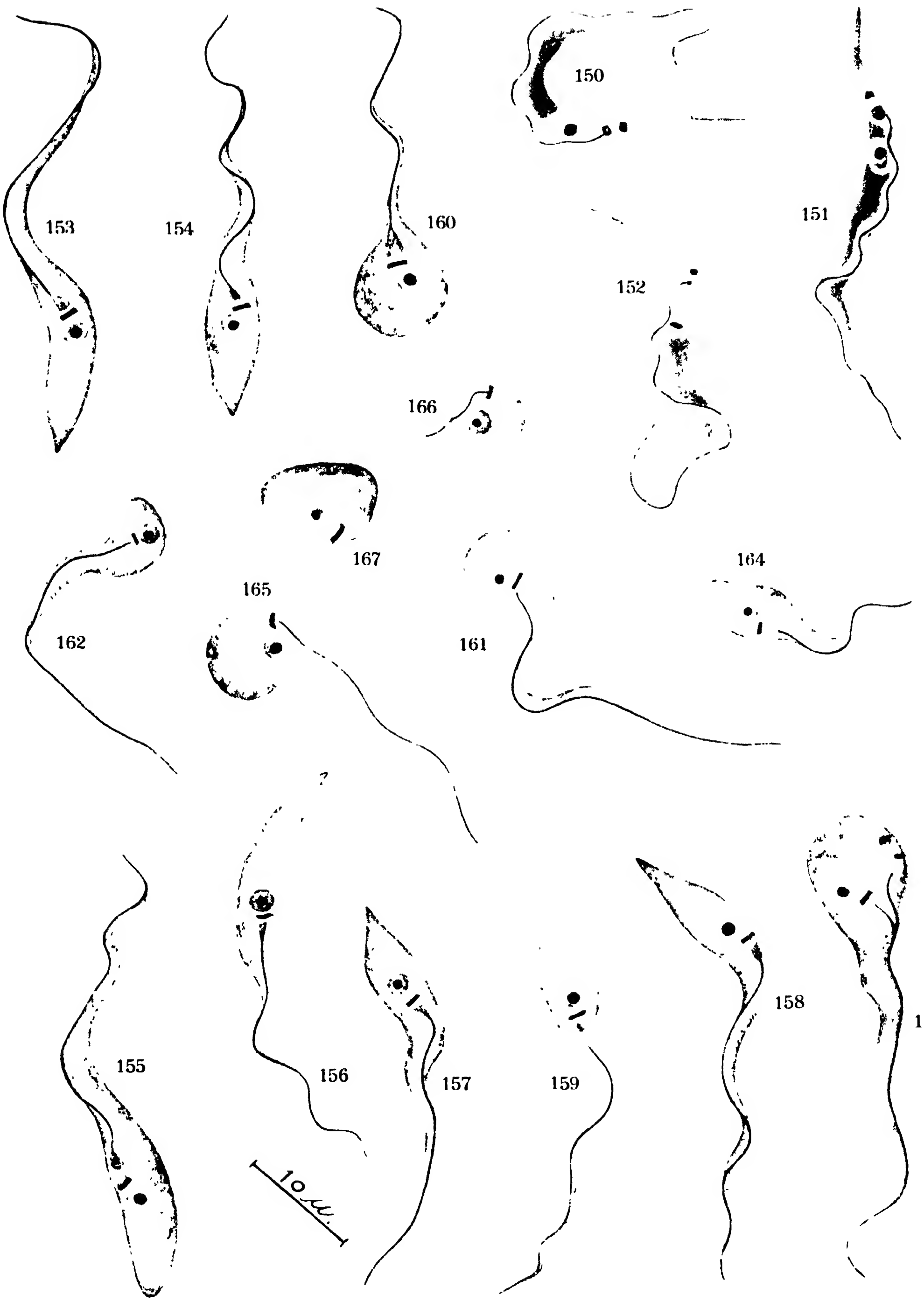
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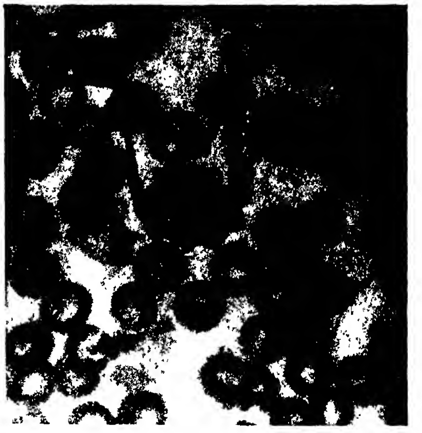

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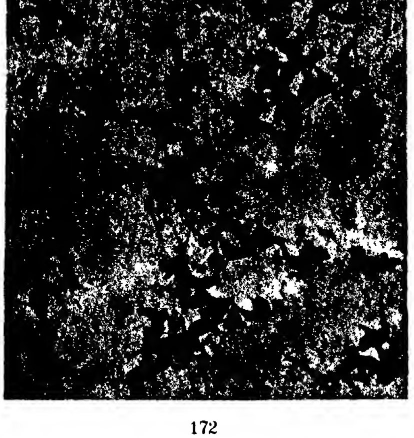

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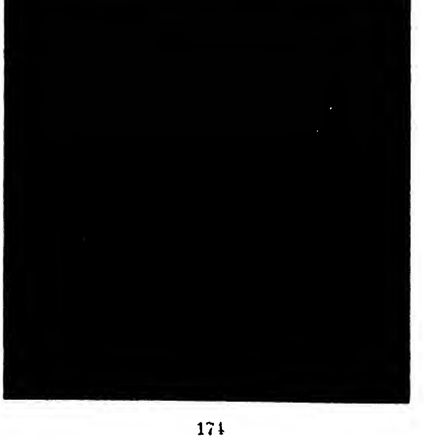

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16. Brief Note on a New Species of Fish Trematodes, Urorchis imba

By Nobutarô Ishii

Government Institute for Infectious Diseases, Tokyo Imperial University

This fluke occurs frequently but in small numbers in the intestine of *Pseudorasbora parva* Temminck et Schlegel from lakes, Imbanuma and Teganuma, in Chiba Prefecture.

The body is subcylindrical, lightly flattened dorsoventrally, broadest in posterior third. The body varies from 1.64 mm to 1.83 mm in length and from 0.48 mm to 0.52 mm in breadth at the acetabular height, although the maximum breadth is 0.59–0.60 mm.

The terminal oral sucker measures 0.16–0.18 mm in diameter; the acetabulum, at the anterior end of the second third of the body length, is spherical and 0.22–0.24 mm in diameter. The oesophagus, 0.11–0.17 mm long and of 0.032–0.039 mm wide, bifurcates about midway between the pharynx and the anterior border of the acetabulum.

The intestinal caeca run parallel to the sides of the body, about midway between the latter and the median line, to the level of the center of posterior testis.

The testes lie almost contiguous one behind the other in the posterior third of the body, and are multilobed and somewhat irregular in shape; the anterior testis is 0.189–0.191 mm long and 0.175–0.207 mm broad, while the posterior testis is 0.143–0.223 mm and 0.191–0.270 mm respectively.

The genital pore is situated on the ventral surface a little in front of the intestinal bifurcation, as far from the median line as from body margin, and leads into a small genital sinus, into which the male and female ducts open. The cirrus pouch is a straight conical body, and in pressed total preparations lies in front of the acetabulum, measuring 0.318 mm long and 0.048–0.056 mm broad; its posterior part is occupied by the seminal vesicle. The winding ejaculatory duct ends in a penis.

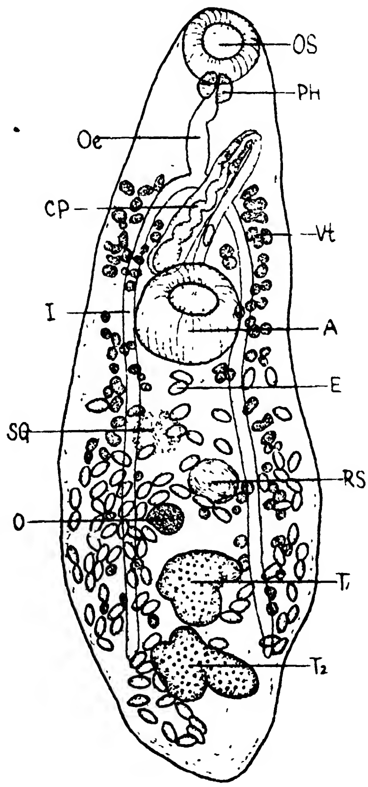

Fig. 1. *Urorchis imba* n. sp.; type. Ventral view.

The pars prostatica is not differentiated, though it contains many small prostatic secretory granules in its lumen. Numerous prostatic cells are present around the pars prostatica and the ductus ejaculatorius, in the anterior third of the cirrus pouch.

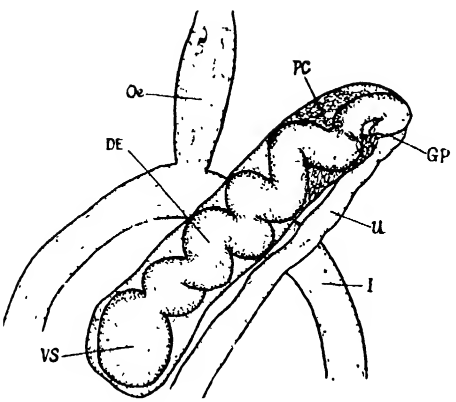

Fig. 2. Cirrus pouch of *Urorchis imba*.

The ovary, situated a little to the right of the median line in front of the anterior testis, is nearly round and measures 0.072–0.095 mm in diameter; from its anterior end starts the oviduct, which after a short course forward joins the receptaculum seminis, and then receives the yolk duct and forms the ootype. The shell glands, diffusely scattered around the ootype, lie in front of the ovary.

From the shell glands the uterus runs down to the posterior end of the body and winds on to the genital pore.

The elliptical eggs lying in a row in the uterus, have very thin shells and measure 0.066–0.075 × 0.028–0.033 mm.

Discussion

Ozaki* (1927) set up a new genus *Urorchis* with the following diagnosis:

"Body thick, muscular, with bluntly rounded extremities; surface unarmed. Oral aperture ventroterminal. Acetabulum preëquatorial. Genital pore preacetabular, lateral. Oral sucker smaller than acetabulum; prepharynx absent; pharynx present; oesophagus fairly long; caeca simple, ending at the posterior level of the front testis. Testes one caudal of the other, intercaecal, near caudal end; cirrus pouch short, anterior to acetabulum. Ovary intercaecal, postacetabular, pretesticular. Receptaculum seminis and Laurer's canal present. Uterus anteroposteriorly and transversely coiled, postacetabular, inter- and extracaecal, extending to the posterior end of the body. Vitellaria with isolated follicles surrounding the whole length of the caeca. Ova with knob-like projection. Excretory vesicle a simple, short, undivided, sac".

The new species above described, which I will call *Urorchis imba*, differs from *U. goro* Ozaki in the following points. The body is broadest in the posterior part. The testes are not elliptical but multilobed. The spiral of the ejaculatory duct has more turns than in *U. goro*. The ovary, seminal receptacle and shell gland are not in the median line. Further differences are shown in the following table.

	Urorchis goro	*Urorchis imba*
Body length	1.72 –2.15 mm	1.64 –1.83 mm
Body breadth	0.45 –0.57 „	0.588-0.604 „
Oral sucker	0.13 –0.165 „	0.159–0.183 „
Pharynx	0.07 „	0.064–0.079 „
Oesophagus	0.16 „	0.111-0.175 „
Seminal vesicle	0.25 –0.32 „	0.318
	×0.08 –0.10 „	×0.048–0.056 „

* Ozaki, Y. Two New Genera of Fish Trematodes. The present Journal, Vol. I, No. 5, 1927, p. 157.

Acetabulum	0.205–0.265 mm	0.223–0.239 mm
Shell gland		0.095–0.111 ,, ×0.079–0.111
Seminal receptacle		0.095–0.127 ,, ×0.048–0.064
Ovary	0.085–0.11 ,,	0.072–0.095 ,,
Anterior testis	0.15 –0.40 ,,	0.159–0.191 ×0.175–0.207 ,,
Posterior testis	0.15 –0.40 ,,	0.143–0.223 ×0.191–0.270 ,,
Egg	0.063–0.072 ×0.038–0.042 ,,	0.066–0.075 ×0.028–0.033 ,,

I take this opportunity to express my sincere thanks to the late Professor Emeritus S. Goto for his kind guidance.

Abbreviations used in Figures

A = acetabulum
CP = cirrus pouch
DE = ejaculatory duct
E = egg
GP = genital pore
I = intestine
O = ovary
Oe = oesophagus
OS = oral sucker
PC = prostata cell
PH = pharynx
RS = seminal receptacle
SG = shell gland
T_1 = anterior testis
T_2 = posterior testis
U = uterus
VS = seminal vesicle
Vt = vitellarium

17. Studies on the Helminth Fauna of Japan
Part 14. Amphibian Trematodes

By Satyû YAMAGUTI
Laboratory of Parasitology, Kyoto Imperial University

CONTENTS

INTRODUCTION

My collection of amphibian trematodes made so far in Japan contains four new species, three new subspecies and seven known species, of which two are encysted adolescariae.

All the trematodes determined by earlier Japanese authors as identical with exotic species have turned out upon careful comparison to be distinct.

POLYSTOMATIDAE Gamb., 1896

1. *Diplorchis ranae* Ozaki, 1931

To Ozaki's detailed description of this common trematode parasitizing the urinary bladder of *Rana rugosa* I will make here some additions and emendations.

The eight pairs of hooks on the sucking disk of the larva have each at the blade an elongate chitinous cap. In the adult, however, this cap may be dropped off or separated from the hook or remain still attached to it or more frequently persist, even though the hook may have been lost.

Ozaki states that the ducts of the prepharyngeal gland cells lead to the anterior end of the pharynx, but so far as I am aware, they open on each side at the bottom of the recess of the prepharyngeal vestibule surrounding the anterior part of the pharynx.

On cursory examination the ceca of the adult may appear continuous posteriorly (fig. 1), but as a matter of fact the cecum of one side is shorter and terminates at about the level of the anteriormost marginal sucker, in direct contact with its fellow of the other side coming across the median line (fig. 2).

The prostatic cells lie outside the cirrus pouch near the distal end of the vas deferens, with their ducts penetrating the pouch. The large cells in the cirrus pouch are of myoblastic nature.

Fig. 1

Fig. 2

Fig. 1-2. Sucking disk of *Diplorchis ranae* Ozaki, 1931; ventral view. Fig. 1. Posterior ends of both ceca appearing continuous. Fig. 2. Same specimen under cover glass pressure; left cecum is in mere contact with right one coming across median line.

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Ozaki, Y. Studies on the frog trematode *Diplorchis ranae*. I. Morphology of the adult form with a review of the family Polystomatidae. Jour. Sci. Hiroshima Univ., Ser. B, Div. I, Vol. 3, Art. 16, 1935.

2. *Polystoma rhacophori* n. sp.

A number of gravid specimens were found on June 10, 1935, in the urinary bladder of *Rhacophorus schlegeli* var. *arborea* from Kurama, near Kyoto.

The elongate body, tapering rapidly toward the somewhat pointed anterior extremity, is 4.5–6.0 mm long by 1.0–1.9 mm broad as fixed in alcohol when alive but may be 9.3 mm long as fixed in alcohol after natural death. The sucking disk, 0.8–1.1 mm long by 1.1–1.6 mm broad, bears six marginal suckers, which are 0.32–0.4 mm in diameter and have well developed radial muscles and a very thick limiting membrane on either surface. At the central base of each sucker the musculature is perforated by a plug of connective tissue containing a mass of gland cells and a retractor of the sucker as in *Diplorchis ranae* Ozaki, 1931. The strongest retractor of the anterior sucker consists of two bundles, one of which splits into individual fibers as soon as it passes into the ventral side of the body proper, and the other runs further forward as a powerful bundle to be finally attached to the dorsal body wall; that of the middle sucker is attached for the most part to the lateral wall of the posterior part of the body proper and partly to the ventral wall, and that of the posterior sucker to the dorsal wall of the disk. The anterior sucker has another powerful muscle bundle attached to its posterior border and running across the median line in front of the disk to the opposite ventral side of the body proper. The corresponding bundle of the middle sucker continues into the ventral

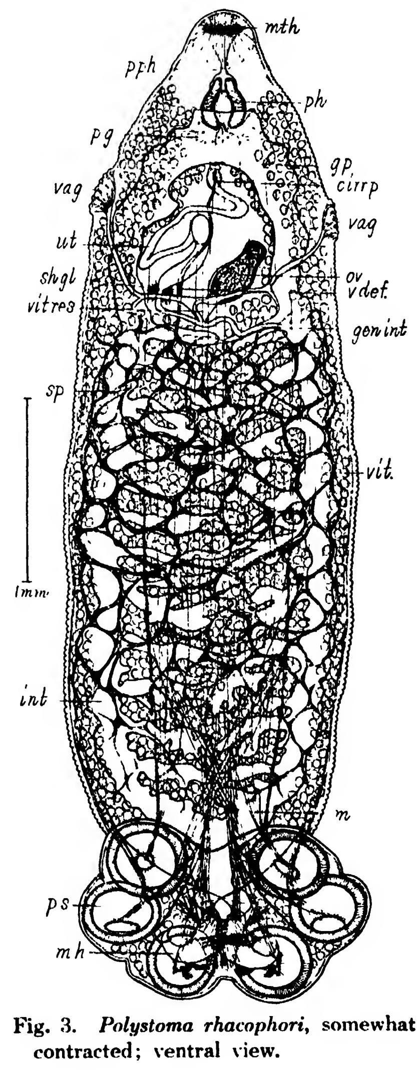

Fig. 3. *Polystoma rhacophori*, somewhat contracted; ventral view.

musculature of the body proper without crossing the median line. The posterior suckers are connected dorsally by transverse bundles attached on either side to the point just medial to the perforated base, while the anterior suckers have no muscular connection. Further there is a small but distinct muscular bundle originating from the posterior end of the body proper and crossing its fellow from the other side to be attached partly to the ventral wall of the disk and partly to the base of the macrohook of the opposite side.

Fig. 4. Macrohooks of *Polystoma rhacophori*; ventral view.

The macrohook (Fig. 4), 0.35–0.42 mm long by 0.21–0.26 mm broad at the base, consists of a short, strongly recurved, terminal claw and a large basal plate with the anterior end truncate or slightly indented. It has no crest-like projection, though only a slight thickening may be present occasionally on either hook. The muscular bundles attached to this hook are just as shown by Ozaki in his fig. 9 for *Diplorchis ranae* (fig. 5). Of the fourteen microhooks 24–27 μ long, three lie on either side along the anterior edge of the disk, one in each sucker, and the last one between the two posterior suckers. The two larger microhooks, 38–42 μ long and with a prominent knob-like guard and a long straight root, lie between the macrohooks and the last pair of smaller microhooks. The cap of the microhook is dropped off or attached to, or detached from, the hook; it measures 27 μ long in the larger hook and 15 μ in the smaller.

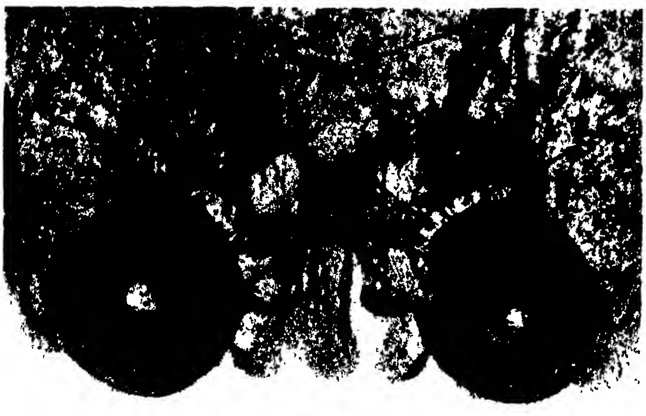

Fig. 5. Posterior end of sucking disk of *Polystoma rhacophori* showing musculature; ventral view.

The cuticle is thin and devoid of spines, but often forms fine annulations due to contraction. Of the subcuticular muscles the strongly developed ventral longitudinal ones are massed at the posterior end of the body proper into two bands, each of which is for the most part attached to the ventral proximal end of the macrohook and partly to the anterior border of the posterior sucker

of its own side.

The wide subterminal mouth opening leads directly into the funnel-shaped buccal cavity, which has numerous longitudinal furrows on the inner surface when alive and is surrounded by radial muscle fibers attached to the body wall. Although there is no definite outer limiting membrane, this part is sharply demarcated from the neck region in the whole mounts stained with iron-hematoxylin. Near the dorsal surface among the radial muscle fibers there are numerous large oval gland cells with dark protoplasm stainable with eosin and a vesicular nucleus containing a distinct nucleolus. These cells have their long axis at right angles to the body surface and seem to discharge their protoplasmic content to the exterior, so that they may be safely looked upon as dermal glands. Similar and much larger gland cells are seen in the intercecal field between the genital pore and the testes directly under the dorsal and ventral subcuticular cell layers; they tend to form a compact mass if there is much available space. The mouth cavity is followed by the prepharynx, whose posterior recess forming a vestibule for the pharynx reaches to the level of the openings of the postpharyngeal glands. It is through the lateral parts of this recess that the intestinal contents are occasionally forced by cover glass pressure from the lateral cecal diverticles directly into the prepharynx. On the dorsal side of the prepharynx lies a broad transverse commissure connecting the symmetrical cephalic ganglia, from each of which arise a ventral submedian trunk and a lateral cord running straight backward through the subcuticular cell layer. The pear-shaped muscular pharynx, $0.188\text{–}0.24 \times 0.188\text{–}0.22$ mm, is divided at the openings of the ducts of the postpharyngeal gland cells into a smaller, purely muscular, anterior and a larger posterior portion, containing a number of myoblastic nuclei surrounded by a finely granular basophil protoplasm, and lined on the inner limiting membrane with the postpharyngeal gland ducts projecting prominently into the lumen. The postpharyngeal gland cells are massed on either side of, behind, and dorsal to, the pharynx, with their long ducts converging to the posterior end of the pharynx; they have a very distinct cell membrane, a granular protoplasm and a spherical nucleus with a thick membrane and containing a comparatively large nucleolus and numerous chromatin granules suspended in the nuclear fluid, which forms a clear zone around the nucleolus. There are no prepharyngeal gland cells as observed in *Diplorchis ranae* Ozaki, 1931. Two pairs of eye-spots lie on the dorsal side, one at the level of the anterior end of the pharynx and the other a little further behind.

There is practically no esophagus. The black intestine with an irregular outline and covering the greater posterior portion of the pharynx from the ventral side extends backwards along the sides of the body into the central part of the sucking disk, where the two limbs usually communicate with each other but terminate rarely in mere contact; it sends out numerous inward branches, which in turn give off branches; the latter may unite with their neighbors. There are secondary but few transverse anastomoses connecting the two main cecal limbs. The epithelial cells resting on the well developed circular

Fig. 6

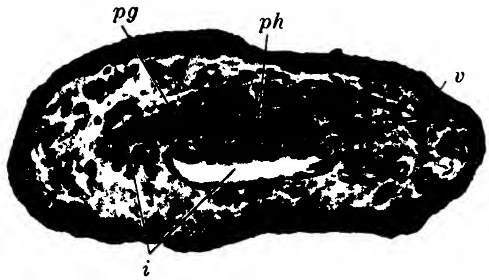

Fig. 7

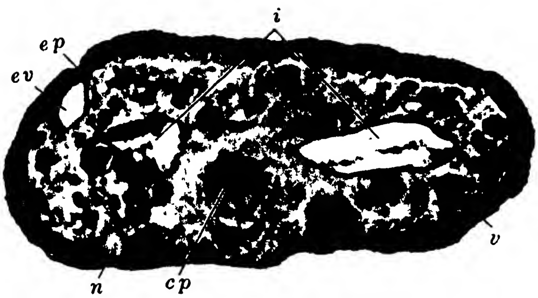

Fig. 8

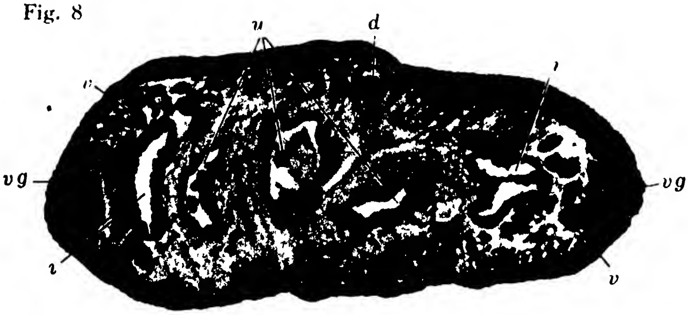

Fig. 9

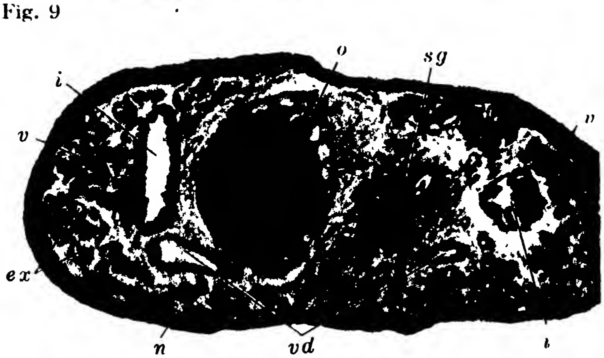

Fig. 6-12. Transverse sections of *Polystoma rhacophori*. Fig. 6. Through posterior end of pharynx. Fig. 7. Through cirrus pouch and excretory pore. Fig. 8. Through vagina. Fig. 9. Through ovary and shell gland.

muscles of the intestine are filled with fine dark pigment granules due to ingestion of the host's blood; some of them desquamate and shed the pigment granules, which are seen driven back and fourth together with the ingesta in living worms.

The testes are transformed, when mature, into a complex network of ducts filled with sperm and occupy the entire postovarian area of the body proper between the ventral subcuticular cell layer and the vitellaria, but do not intrude into the sucking disk. The vas deferens, arising slightly to the right or left of the median line at the level of the junction of the four female genital ducts, proceeds anterodorsad to take a more or less sinuous course dorsal to the uterus and finally turns anteroventrad to continue into the pars prostatica enclosed in an oval muscular cirrus pouch containing several myoblastic cells similar to those of the pharynx. The not very numerous prostatic cells with fine eosinophil granules are scattered near the distal end of the vas deferens, with their ducts penetrating the pouch. The very short cirrus

tipped with a crown of 8 acicular spines about 42 μ long opens directly in front of the female aperture into the common genital sinus, which in turn opens to the exterior just behind the intestinal arch.

The retort-shaped ovary, 0.42–0.63 × 0.21–0.34 mm, is somewhat constricted near its blunt, ventrally curved, anterior end and lies obliquely on the right or left of the median line, with its center dividing the body length in the ratio of 1 : 3–4.3. The germiduct arising from the base of the ovary describes a strong curve on the dorsal side of the large vitelline reservoir and joins the posterior end of the latter to be continued into the uterine duct. From this junction is given off the ductus genito-intestinalis, which runs backward and outward in a more or less sinuous course to open into the cecum of the ovarian side. The shell gland lies opposite the ovary at the proximal end of the large spindle-shaped ootype, the distal end of which continues into the uterus proper coiling forward between the two intestinal limbs. The elongate oval, brown, thin-shelled eggs, usually one and rarely ten or more in number, are 0.238–0.3 mm long by 0.14–0.163 mm broad in life; the contained ovum, 38 μ in diameter, is not segmented.

Fig. 10

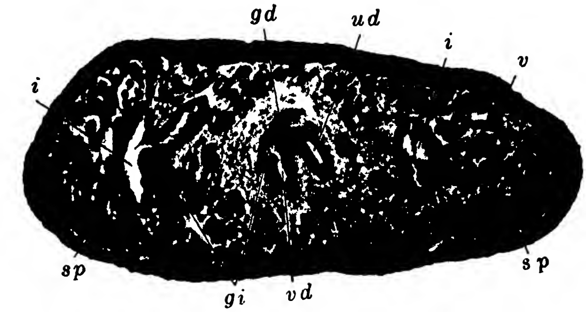

Fig. 11

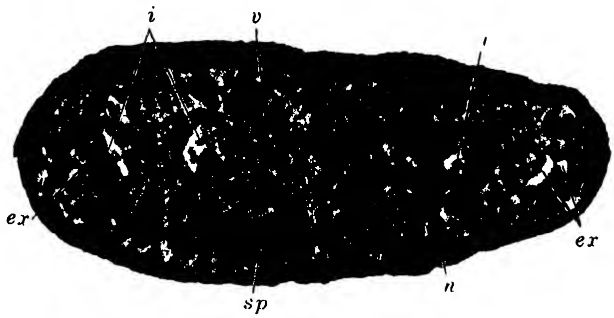

Fig. 12

Fig. 10. Through junction of four genital ducts and opening of ductus genito-intestinalis. Fig. 11. Through point of bifurcation of left excretory stem. Fig. 12. Through anterior suckers of sucking disk.
cp cirrus pouch, *d* vas deferens, *ep* excretory pore, *ev* excretory vesicle, *ex* excretory canal, *gd* germiduct, *gi* ductus genito-intestinalis, *i* intestine, *n* nerve trunk, *o* ovary, *u* uterus, *ud* uterine duct, *ph* pharynx, *pg* post-pharyngeal gland cells, *sg* shell gland, *sp* sperm, *v* vitellaria, *vd* vitelline duct, *vg* vagina.

The exceedingly numerous, closely packed vitelline follicles begin at the

level of the pharynx along each side of the body but soon extend over the intestine both dorsally and ventrally; from behind the ovary to the base of the macrohooks they surround the intestine and its branches on all sides and intrude into the space between the anterior and middle suckers as well as between the middle and posterior suckers. The raised vagina lies on either lateral margin of the body between the cirrus pouch and the ovary. The numerous narrow ducts perforating the vagina unite altogether at the base of the latter into a wide vaginal duct, which runs posteromesad to join the vitelline duct ventral and slightly medial to the intestine and vitellaria.

The excretory system is in its general plan just the same as that of *Diplorchis ranae* Ozaki. The rounded vesicle opening on the dorsal surface lies on either side about midway between the vagina and the pharynx or a little nearer the former. The excretory stem projecting into the vesicle runs backward under the subcuticular cell layer along the ventrolateral margin of the body and divides some distance behind the ovary into an anterior and a posterior collecting tubules. The anterior collecting tubule ascends along the stem on the dorsal side and then parallel to its own recurrent branch to near the anterior end of the pharynx, where it turns anterolaterad and after describing a twisted loop comes back again to divide into an anterior and a posterior branches. Between the anterior or posterior branches of the two sides is a short transverse anastomosis passing dorsal to the anterior end of the pharynx. The posterior collecting tubule runs into the sucking disk and after uniting at about the middle of the disk with its fellow of the other side by a short transverse anastomosis turns back on itself to bifurcate into an anterior branch terminating in the posterior part of the body proper and a posterior one terminating in the lateral half of the disk of its own side.

DISCUSSION. This species differs from the closely related *Polystoma integerrimum* (Froelich, 1791) chiefly in the body size and in the macrohook. In the latter species the macrohook has a crest-like projection and a pronounced basal incision, while in the present species it has no such characteristics.

Polystoma rhacophori n. sp.

SPECIFIC DIAGNOSIS. *Polystoma* Zeder, 1800. Body 4.5–6.0 × 1.0–1.9 mm as fixed in alcohol when alive, 9.3 mm long as fixed in alcohol after natural death. Sucking disk 0.8–1.1 × 1.1–1.6 mm. Marginal suckers 0.32–0.4 mm in diameter. Macrohook without crest-like projection or pronounced basal incision, 0.35–0.42 × 0.21–0.26 mm. Larger microhook 38–42 μ long, with cap 27 μ long; smaller microhook 24–27 μ long, with cap 15 μ long. Testes reticular when mature, occupying entire ventral postovarian area of body proper. Genital spines 8 in number, 42 μ long. Ovary retort-shaped, 0.42–0.63 × 0.21–0.34 mm; its center dividing body length in ratio of 1:3–4.3. Eggs usually one, sometimes over 10 in number, 0.238–0.3 × 0.14–0.163 mm. Vitellaria extending from pharyngeal level to base of macrohooks, intruding into space between suckers.

Habitat. Urinary bladder of *Rhacophorus schlegeli* var. *arborea*.

Locality and date. Near Kyoto; June 10, 1935.

Type and paratypes in my collection.

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Zeller, E. Untersuchung über die Entwicklung und Bau des *Polystomum integerrimum* Rud. Zeitschr. f. wiss. Zool., Bd. 22, 1872, p. 1-28.

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PARAMPHISTOMIDAE Fischoeder, 1901

3. *Diplodiscus amphichrus japonicus* n. subsp.

DESCRIPTION. This is one of the commonest frog trematodes in Kyoto. The conical body is 1.5-2.5 mm long and 0.4-1.0 mm broad behind its middle. The cuticle, 4-6 μ thick, is smooth throughout except on the borders of the oral and posterior suckers with minute marginal papillae. The subcuticular cells are segregated into numerous compact masses of irregular outline. The eye-spot of the larval stage persists on either side of the esophagus near the dorsal surface as a compact, or more usually, loose mass of pigment granules. The oral sucker, 0.15-0.23 mm broad and 0.25-0.37 mm long including the diverticula, is muscular in the anterior part but contains posteriorly very numerous nuclei. The esophagus, 0.33 mm long and beginning 0.15 mm behind the anteroventral border of the oral sucker in the type 2.37 mm long, is lined by a thick cuticle and surrounded by compact masses of Begleitzellen, which are continued over the esophageal bulb measuring $0.12\text{-}0.15 \times 0.1\text{-}0.13$ mm. The wide simple ceca terminate near the posterior sucker, which is oval, 0.47-0.8 mm in longer transverse diameter and has at its middle a transversely elongate oval, prominent navel with a central pit and well developed radial muscle fibers.

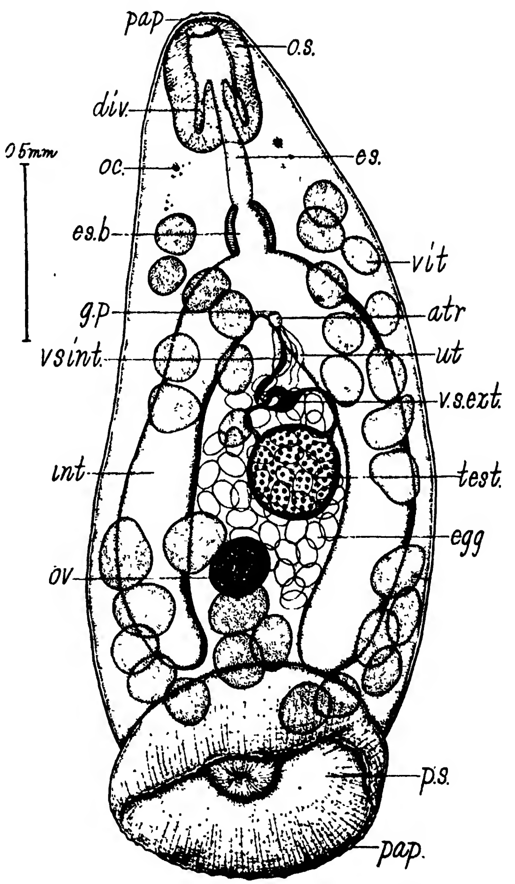

Fig. 13. *Diplodiscus amphichrus japonicus*. Type; ventral view.

The single subglobular testis, 0.18–0.37 × 0.2–0.33 mm, lies ventral to the uterus at about the middle of the body or a little further behind, very slightly out of the median line. Each vas deferens arising from the anterolateral edge of the testis, forms dorsal to the vitelline follicles of its own side an outwardly directed loop and then unites with each other in front of the testis to form a sinuous vesicula seminalis externa with a characteristically triangular base.

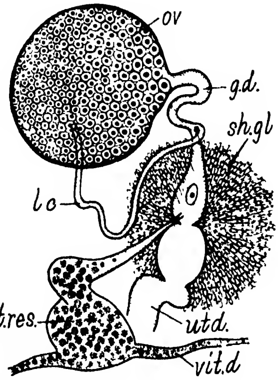

Fig. 14. Ovarian complex of *Diplodiscus amphichrus japonicus*; ventral view.

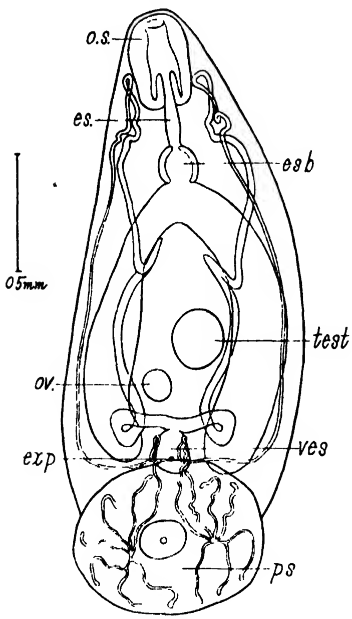

Fig. 15. Excretory system of *Diplodiscus amphichrus japonicus*; ventral view.

The elongated cirrus pouch, 0.16 × 0.1 mm in a flattened specimen 2.35 mm long, has a very thin membranous wall. The vesicula seminalis interna has a much thicker wall than the externa, and is surrounded at its attenuated distal end by a small number of prostatic cells. The pars prostatica is not distinctly differentiated. The ductus ejaculatorius, which is not clearly distinguishable from the distal end of the vesicula seminalis interna, opens directly dorsal to the female aperture into the oval genital atrium, which in turn opens outside just behind the cecal bifurcation.

The subglobular to oval ovary, 0.13–0.25 × 0.16–0.2 mm, lies behind the testis, a little to one side of the median line. The sinuous germiduct, arising from the median border of the ovary, gives rise to the Laurer's canal and then enters the shell gland, in which it becomes fairly wide but is notably constricted at its junction with the duct from the vitelline reservoir. The large vitelline follicles, 30–40 in all, extend on the ventral side of the ceca between the eye-spots and the posterior sucker, in front of which they appear continuous across the median line. The uterine coils are confined to the dorsal part of the intercecal field. The elongate oval, thick-shelled eggs are 102–126 × 66–78 μ. The Laurer's canal opens on the dorsal surface opposite the ovary.

The primary excretory tubule of each side takes its origin in the posterior sucker, where it divides on either side of the central navel mentioned above into six radial branches reaching to the margin of the sucker; it passes forward into the body proper and turns back on itself on the ventrolateral surface of the excretory vesicle to take a transverse course toward the side of the body, where

it turns forward at right angles and reaches to near the diverticle of the oral sucker to continue into the descending main collecting tubule crossing the cecum of its own side between the latter and the vitelline follicles. This tubule turns dorsad in front of the testis along the medial wall of the cecum to continue into the excretory arm, which runs backward dorsal or dorsomedial to the cecum, and after describing a loop ventral to the cecal end, unites with its fellow of the other side to open into the vesicle at its anterior end. The latter opens on the dorsal surface of the body in front of the posterior sucker.

DISCUSSION. This worm has been confused by Seno, Fukui and others with *Diplodiscus subclavatus* (Pallas, 1760), in spite of the marked differences in the size of the body and eggs. I regard it as a subspecies of *D. amphichrus* Tubangui, 1933, because of the vitelline follicles not meeting anteriorly in the median line. Fukui's description that in "*D. subclavatus* (Pallas, 1760)" the excretory tubules from the posterior sucker open directly into the vesicle is unquestionably erroneous.

Diplodiscus amphichrus japonicus n. subsp.

SUBSPECIFIC DIAGNOSIS. *Diplodiscus amphichrus* Tubangui, 1933. Body 1.5–2.5 × 0.4–1.0 mm, with minute marginal papillae on oral and posterior suckers. Oral sucker including its diverticula 0.25–0.37 mm long, 0.15–0.23 mm broad. Esophageal bulb 0.12–0.15 × 0.1–0.13 mm. Ceca reaching to near posterior sucker. Posterior sucker 0.47–0.8 mm in transverse diameter, with prominent central navel. Testes subglobular, 0.18–0.37 × 0.2–0.33 mm. Ovary 0.13–0.25 × 0.16–0.2 mm. Vitelline follicles large, 30–40 in all. Eggs 102–126 × 66–78 μ.

Habitat. Large intestine of *Rana nigromaculata* (type host), *R. rugosa* and *Megalobatrachus japonicus*.

Locality. Kyoto.

Type and paratypes in my collection.

LITERATURE CITED

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HEMIURIDAE Lühe, 1901

4. *Halipegus japonicus* n. sp.

DESCRIPTION. The following description is based on eight mature specimens from under the tongue of *Rana nigromaculata* from Nagano Prefecture and a similar one, swallowed with the host, from the stomach of *Elaphe quadrivirgata* in Kyoto. The plump body, 2.17–5.38 mm long by 0.65–1.6 mm broad at the level of the testes or ovary, is bluntly pointed in front but rounded behind, and covered by a thick cuticle. There is a very prominent preoral lip 0.07–0.11 mm thick. The subterminal oral sucker is 0.225–0.68 mm, and the

pharynx 0.09–0.2 mm, in diameter. The short esophagus runs ventroposteriad from the pharynx and opens into the intestine from the ventral side. The two ceca, lined by cuticle at the beginning and forming an arch in front, come to lie behind the acetabulum dorsal or dorsomedial to the testes and terminate in close contact with each other at the extreme posterior end of the body. The acetabulum, 0.32–1.1 mm in diameter and 1.4–1.8 times as large as the oral sucker, lies at the middle of the body or just in front of it.

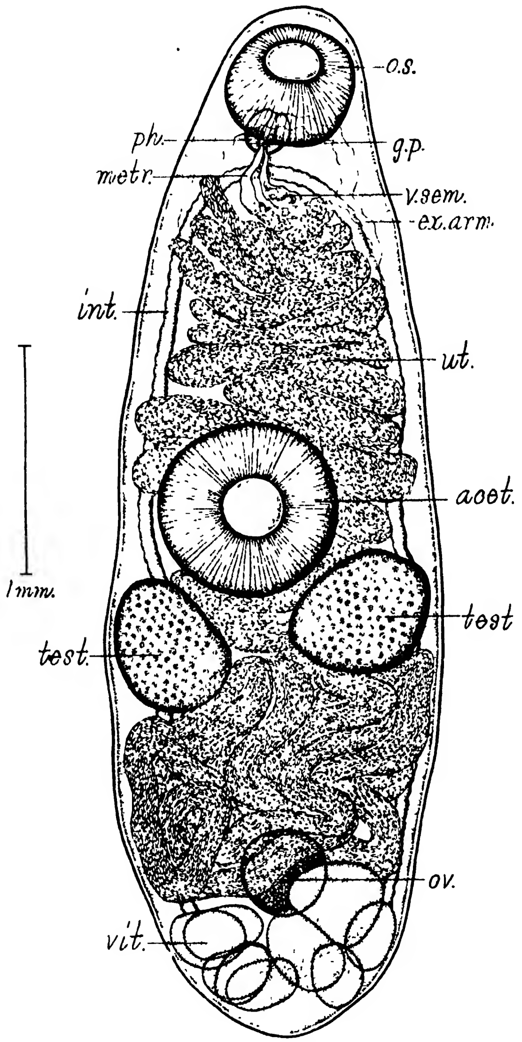

Fig. 16. *Halipegus japonicus*. Type; ventral view.

The subglobular testes, 0.28–0.75 × 0.23–0.68 mm, are situated just behind the acetabulum on the same level or a little obliquely one behind the other, with a few uterine coils between. The vesicula seminalis and the prostatic cells are well developed. The genital pore lies at the level of the pharynx or behind it.

The ovoid dorsal ovary, 0.21–0.56 × 0.2–0.5 mm, lies in the type 4.4 mm long almost in the median line but a little aside in the paratypes. The Laurer's canal opening on the dorsal surface is swollen at its proximal half to form a tubular receptaculum seminis (fig. 17). The compact median shell gland lies behind the ovary and the posterior end of the uterus. The rosette-shaped vitellarium, 0.3–0.88 × 0.15–0.75 mm and lying on either side at the posterior end of the body, consists in the type and a paratype of 5 lobes on the right and 4 lobes on the left, but in the other two paratypes of 4 lobes on the right and 5 lobes on the left. The vitelline ducts arising from the center of each vitellarium on its inner side unite in the median line just behind the shell gland. The uterus forms a compact mass of coils between the testes and the vitellaria as well as between the acetabulum and the cecal arch. The elongate elliptical eggs as measured in life are 45–48 × 16–18 μ and their polar filament may be up to 0.3 mm long.

The two sinuous excretory arms are united with each other on the dorsal side of the oral sucker or pharynx.

DISCUSSION. This worm differs from the most closely related *Halipegus occidualis* Stafford, 1905, in the length of eggs, and from *H. mehransis* Srivastava, 1933, in the possession of a distinct esophagus.

The specimens which Seno identified with *H. occidualis* Stafford, 1905, probably belong to the present species.

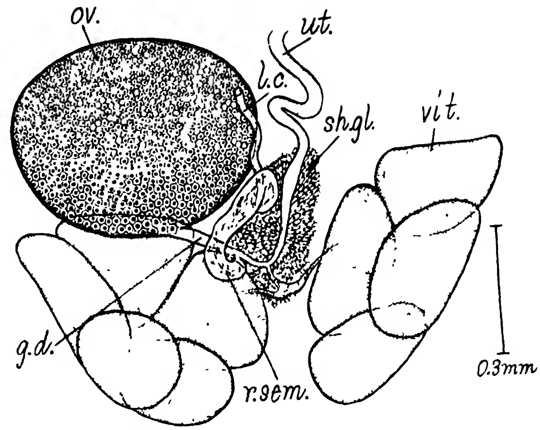

Fig. 17. Ovarian complex of *Halipegus japonicus*; dorsal view.

Halipegus japonicus n. sp.

SPECIFIC DIAGNOSIS. *Halipegus* Looss, 1899. Body 2.17–5.38×0.65–1.6 mm. Oral sucker 0.225 0.68 mm in diameter. Pharynx 0.09–0.2 mm in diameter. Acetabulum 0.32–1.1 mm in diameter, equatorial or pre-equatorial. Testes 0.28–0.75×0.23–0.68 mm, just behind acetabulum. Ovary 0.21–0.56×0.2–0.5 mm. Vitellarium 0.3–0.88×0.15–0.75 mm, with 4 or 5 lobes each. Eggs 45–48×16–18 µ; polar filament up to 0.3 mm long.

Habitat. Under tongue of *Rana nigromaculata*.

Locality. Nagano Prefecture (type locality); Kyoto.

Type and paratypes in my collection.

LITERATURE CITED

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GORGODERIDAE Looss, 1901

5. *Gorgodera japonica* n. sp.

Numerous specimens were found in the urinary bladder of *Rana nigromaculata* from Kamisuwa, Nagano Prefecture.

The elongate fusiform body as fixed in alcohol, stained and mounted, is 3.5–5.5 mm long and 0.6–1.0 mm broad at about the middle of the hindbody, the posterior end of which is more or less sharply pointed. The cuticle is smooth. The subterminal oral sucker is 0.2–0.325 mm in diameter. The very prominent acetabulum, 0.525–0.77 mm in diameter, lies within the anterior third of the body. The esophagus, about 0.2 mm long in the type 4.5 mm long, is

lined by a thick cuticle and surrounded by numerous Begleitzellen. The ceca reaching to near the posterior extremity are narrow and lined by cuticle at the very beginning, but moderately wide elsewhere.

The nine testes, more or less rounded, with irregular indentations on the surface, lie in two series, usually 5 on the ovarian side and 4 on the other, but sometimes rather irregularly. There is no cirrus pouch. The ovoid vesicula seminalis, usually overlapping the acetabulum, narrows suddenly into a coiled duct, the distal end of which forms the pars prostatica surrounded by prostatic cells. The genital pore lies immediately behind the intestinal bifurcation.

The ovary 0.25–0.44 × 0.18–0.31 mm, is ovoid, reniform, indented or lobed and lies at the second fourth of the body a little out of the median line. The germiduct arising from the dorsomedial part of the ovary widens into a spindle-shaped receptaculum seminis before giving rise to the Laurer's canal, which runs transversely to the opposite side of the ovary and opens dorsally. After the union with the vitelline reservoir by a short narrow duct, the germiduct turns backward over the

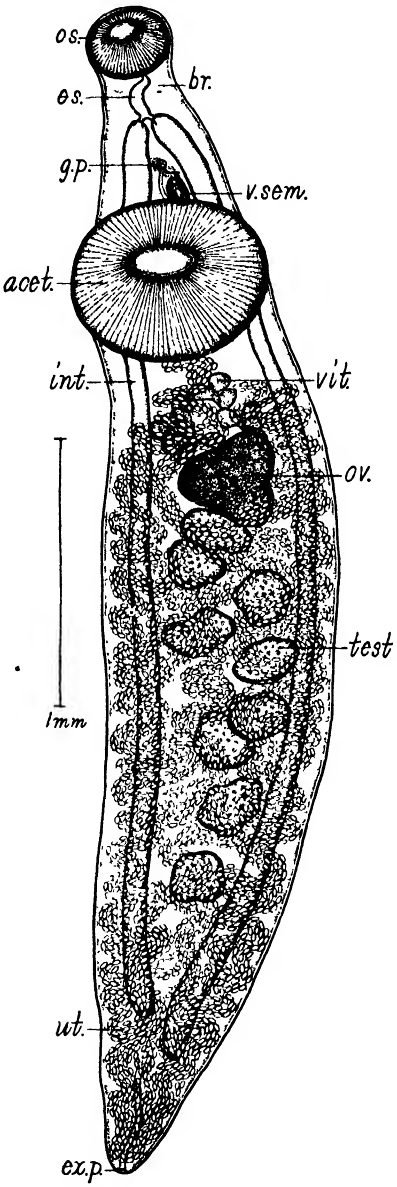

Fig. 18. *Gorgodera japonica;* ventral view.

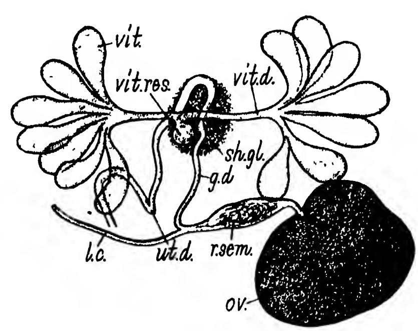

Fig. 19. Ovarian complex of *Gorgodera japonica;* dorsal view.

transverse vitelline duct or the vitelline reservoir. The narrow uterine coils fill up all the available space of the hindbody as is usual in *Gorgodera* but

may or may not occupy the lateral fields between the ovary and the acetabulum. The ellipsoidal, thin-shelled, embryonated eggs are 40–44 × 27–31 μ in life. The vitelline rosettes of each side consist in the majority of cases of 7, rarely 6 or 8 lobes.

The narrow tubular excretory vesicle opens at the posterior tip of the body.

DISCUSSION. This species differs from the closely related *G. cygnoides* (Zeder, 1800) Looss, 1899, and *G. australiensis* Johnston, 1912, chiefly in the size of the body and eggs. It seems certain that *G. cygnoides* (Zeder) of Seno from the suburb of Tokyo belongs to the present species, though the author has failed to give the egg measurements

Gorgodera japonica n. sp.

SPECIFIC DIAGNOSIS. *Gorgodera* Looss, 1899. Body 3.3–5.5 × 0.6–1.0 mm, more or less pointed posteriorly. Oral sucker 0.2–0.325 mm in diameter. Acetabulum very prominent, 0.525–0.77 mm in diameter. Testes usually 5 on ovarian side, 4 on the other. Ovary ovoid, reniform, indented or lobed, 0.25–0.44 × 0.18–0.31 mm. Vitelline rosette of each side consisting usually of 7, rarely 6 or 8 lobes. Embryonated eggs 40–44 × 27–31 μ in life.

Habitat. Urinary bladder of *Rana nigromaculata.*

Locality and date. Nagano Prefecture; May 15, 1935.

Type and paratypes in my collection.

LITERATURE CITED

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Seno, H. Distomes of Japan. Dobutu Gaku Zassi, Vol. 19, 1901, p. 121–123.

6. *Phyllodistomum patellare* (Sturges, 1897)

Syn. *Phyllodistomum entercolpium* Holl, 1930

Some ten fully matured specimens were found in the urinary bladder of *Diemyctylus pyrrhogaster* from Kyoto. A comparison of these with the two mounted paratypes* of Holl deposited in the Zoological Institute of the Tokyo Imperial University showed that they agree well with each other. Holl states that the seminal receptacle is absent, but it may be formed by the spindle-shaped expansion of the germiduct.

The following measurements in mm were made on eight specimens fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam: Body 2.5–3.2 × 1.3–1.92; oral sucker 0.43–0.5 in diameter; acetabulum 0.46–0.6 in diameter; anterior testis 0.46–0.56 × 0.28–0.48; posterior testis 0.52–0.63 × 0.35–0.48; ovary 0.23–0.38 × 0.23–0.33.

*For the loan of the specimens I am very much indebted to Prof. Yatsu, Director of the Institute.

In my material as well as in Holl's paratypes the eggs measure 27–33 × 18–23 μ, although Holl gives for them an average measurement of 39 × 25 μ, so that I agree with Dollfus (Ann. Parasit., IX, 192, note 2) in synonymizing *P. entercolpium* with *P. patellare*.

Literature cited

Holl, F. J. *Phyllodistomum entercolpium*, a new trematode from *Diemyctylus pyrrhogaster* Boie. Annot. Zool. Japan., Vol. 12, No. 2, 1930, p. 149–151.

Plagiorchiidae Ward, 1911

7. *Enodiotrema rugocaudatum* Yoshida, 1916

This species has been reported by Yoshida from the common frog, *Rana nigromaculata*, but occurs much more frequently in *Rana rugosa* Schlegel in Kyoto and vicinity.

With regard to the anatomy of the worm I will make here some remarks on some inaccuracies in Yoshida's description.

In mature individuals, on which the measurements given below were made, the body is 1.15–4.2 mm long by 0.5–1.1 mm broad, the two dimensions having a ratio of 2–4 : 1 according to different states of contraction. On either side of the esophagus and in its vicinity there are numerous roundish to pyriform gland cells, containing strongly refractive granules, and whose ducts apparently open to the exterior along the anterior border of the oral sucker. As usual in this type of trematodes with the cervical glands* mentioned above, there is always a distinct preoral lip, which may however disappear when flattened under a cover glass. The oral sucker and the acetabulum vary from 0.125 to 0.23 mm and from 0.1 to 0.188 mm respectively in the anteroposterior dimension, which is less affected by cover glass pressure than the transverse one.

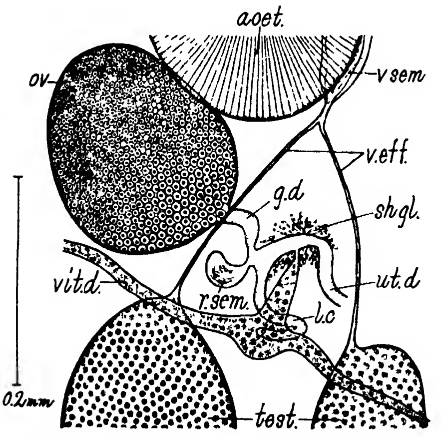

Fig. 20. Ovarian complex of *Enodiotrema rugocaudatum* Yoshida, 1916; ventral view.

The roundish to oval testes are 0.18–0.51 mm long by 0.125–0.4 mm broad, and the ovary is 0.15–0.35 mm long by 0.13–0.3 mm broad. The receptaculum seminis is usually retort-shaped. The Laurer's canal, arising at the junction of the germiduct with the seminal receptacle, takes a sinuous course and opens in the middorsal line at the level of the vitelline reservoir. In Yoshida's figure

*So named in the first part of this series, p. 80.

8 the Laurer's canal is shown as opening at the level of the anterior end of the ovary in contradiction of his correct description. In the same figure there is another error in that the common vitelline duct is shown to meet the germiduct at the junction of the latter with the receptaculum seminis and Laurer's canal. In one of my specimens stained with iron-hematoxylin, the vitelline duct from the deltoid vitelline reservoir is very clearly seen to unite with the germiduct a little distally to the junction above mentioned.

The vitellaria are stated and figured by Yoshida to begin at about the level of the testes, but in most of my material they begin somewhat further in front or even at the level of the intestinal bifurcation.

The tubular excretory vesicle is surrounded by a compact mass of cells between its ventroterminal opening and the fusiform posterior expansion; it bifurcates just behind the testes into two arms, which in turn divide each at the ovarian level into an anterior and a posterior collecting tubule receiving smaller branches at intervals. The flame cell formula is $2 \times 6 \times 3$ according to Yahata.

LITERATURE CITED

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Yoshida, S. On a new species of frog trematode (*Enodiotrema rugocaudatum* n. sp.). Annot. Zool. Japan., Vol. 9, 1916, p. 73-79.

8. *Pneumonoeces sibiricus japonicus* n. subsp.

DESCRIPTION. A number of this worm were found in the lung of *Rana nigromaculata* from the suburb of Kyoto. Most of them were fixed in alcohol in a stretched condition, stained with hematoxylin-eosin and mounted in balsam. The body, 6.0–8.7 × 1.0–2.4 mm, tapers anteriorly but is rather rounded behind, with the maximum breadth at different levels of the hindbody according to the state of contraction. The cuticle is densely beset with exceedingly fine spines, which are recognizable only under high magnification. The cervical glands are not clearly observable. The subcuticular cells form a thick compact layer throughout the body. There is a distinct preoral lip. The subterminal oral sucker is 0.3-0.45 mm long by 0.34–0.5 mm broad. The barrel-shaped pharynx is 0.15–0.23 mm in diameter. The esophagus is 0.2 mm long in the type 8.7 mm long The sinuous ceca terminate, well apart from each other, near the posterior end of the body. The acetabulum, constantly larger than the oral sucker (ratio 1.2–2.0 : 1 in the specimens mounted in balsam under cover glass pressure but 1.0–1.27 : 1 in those mounted in lactophenol without pressure), measures 0.4–0.8 mm in diameter and divides the body length in the ratio of 1 : 2.33 in the type.

The elongate testes 0.9–1.7 × 0.3–0.7 mm, are situated obliquely tandem at the middle of the posterior half of the body, the size ratio of the two being somewhat variable. The long cirrus pouch contains an elongate seminal vesicle,

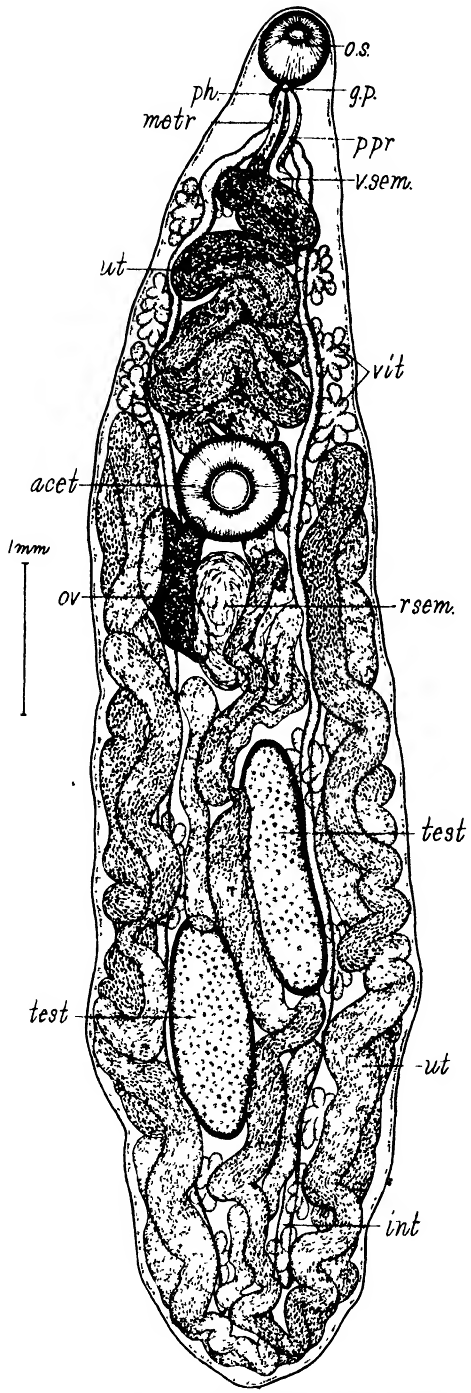

Fig. 21. *Pneumonoeces sibiricus japonicus*. Type; ventral view.

a cylindrical pars prostatica surrounded by prostatic cells and a protrusible cirrus, with its greater portion hidden by the uterine coils. The relatively wide ventral genital pore lies at the level of the posterior end of the oral sucker.

The irregularly lobed ovary, 0.65–1.0 × 0.28–0.57 mm, lies on the right or left of the median line behind the acetabulum, with its anterior end usually reaching to the equatorial level of the latter; it may be simply bean- or kidney-shaped or have one or two slight indentations on the lateral border. The very voluminous receptaculum seminis lies ventral to the shell gland and directly medial to the ovary. The vitelline rosettes, 16–20 in all and beginning some distance behind the intestinal bifurcation, lie on either side at irregular intervals dorsal to the intestine and uterus, with a certain tendency to mass in the preacetabular region and at the cecal terminations. The descending proximal and ascending distal portions of the uterus are confined to the intercecal field, while the middle portion describing a loop along each side of the body reaches to the acetabular level or slightly beyond. In front of the acetabulum the uterus forms a large compact mass of coils, which usually does not extend further outward than the ceca. The straight, relatively wide metraterm lined by cuticle has a thick coat of Begleitzellen. The elongate oval, light brown, embryonated eggs are 26–33 μ long by 15–21 μ broad; when cultured in tap water at room temperature (June 25–27, 1934), the miracidia emerged in two days. The latter are ciliated all over, about 27 μ long by 18 μ broad and have a prominent snout devoid

of cilia.

DISCUSSION This worm is distinguished from *Pneumonoeces sibiricus* Issaitschikow of Bychowsky merely by egg size.

In 1907 Seno reported two *Pneumonoeces* species (*variegatus* Rud., 1819, and *lobatus* n. sp.) from Japanese *Rana nigromaculata*, but I have not yet met with either of the two in the frogs of Kyoto and vicinity

Pneumonoeces sibiricus japonicus n. subsp.

SUBSPECIFIC DIAGNOSIS. *Pneumonoeces sibiricus* Issaitschikow, 1927. Body 6.0–8.7 × 1.0–2.4 mm. Oral sucker 0.34–0.5 mm in diameter. Pharynx 0.15–0.23 mm in diameter. Acetabulum 0.4–0.8 mm in diameter. Testes elongate, entire, 0.9–1.7 × 0.3–0.7 mm. Ovary irregularly lobed or indented, bean- or kidney-shaped, 0.65–1.0 × 0.28–0.57 mm. Vitelline rosettes 16–20 in all. Eggs 26–33 × 15–21 μ.

Habitat. Lung of *Rana nigromaculata*.

Locality and date. Suburb of Kyoto; June 25, 1934.

Type and paratypes in my collection.

9. *Pneumonoeces nanchangensis major* n. subsp.

Some ten specimens were found in the lungs of *Rana nigromaculata* from Fukuoka Prefecture.

The worm agrees well with Hsiung's description of *P. nanchangensis*, but on the basis of the following differences of minor importance I regard it as a subspecies of the Chinese species.

The body is larger than *P. nanchangensis* and the genital organs are also proportionally larger. The oral sucker is usually just as large as the acetabulum, but may be slightly larger or smaller. The nearly symmetrical

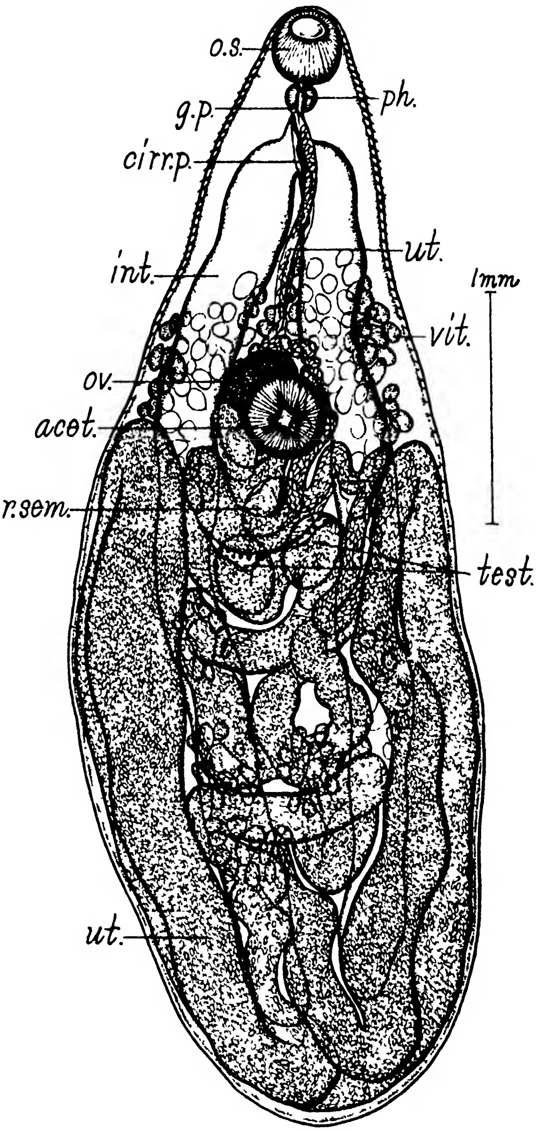

Fig. 22. *Pneumonoeces nanchangensis major*; ventral view.

testes may well touch each other.

Pneumonoeces nanchangensis major n. subsp.

SUBSPECIFIC DIAGNOSIS. *Pneumonoeces nanchangensis* (Hsiung, 1934). Body 3.7–4.7 × 1.2–2.0 mm, covered anteriorly by minute sharp spines up to 18 μ long. Cervical gland present. Oral sucker 0.28–0.36 mm in diameter. Pharynx 0.1–0.17 mm in diameter. Esophagus up to 0.35 mm long. Acetabulum 0.3–0.38 mm in diameter, about half as far from anterior as from posterior extremity. Testes subglobular to oval, 0.28–0.58 × 0.22–0.53 mm, usually equatorial, with voluminous receptaculum seminis between their anterior parts; the one of the ovarian side may often touch the ovary. Ovary ellipsoidal or reniform, 0.5–0.65 × 0.27–0.38 mm, in acetabular zone. Extracecal uterine coils reaching to testicular or ovarian level, but occasionally further forward on one side. Vitellaria in 4 groups, 8–12 rosettes in front, 6–8 behind. Eggs elongate oval, 36–39 × 20–24 μ, slightly notched at antiopercular pole.

Habitat. Lungs of *Rana nigromaculata.*

Locality and date. Fukuoka Prefecture; April 25, 1935.

Type and paratypes in my collection.

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Seno, H. Distomes in Japan. Dobutu Gaku Zassi, Vol. 19, 1907, (Japanese).

10. *Encyclometra japonica* Yoshida et Ozaki, 1929 (larva)

The metacercariae of this species were found encysted in the abdominal muscles of *Rana nigromaculata* from the vicinity of Kyoto. The cyst is oval, thick-walled and 1.2–1.5 mm in diameter. The free metacercaria as fixed in Schaudinn's solution under slight cover glass pressure is up to 3.2 mm long by 1.0 mm broad. The preoral lip and the cervical glands are well developed. The suckers and the digestive and reproductive organs are found in just the same places as in the adult. The most conspicuous feature is the large excretory vesicle filled with opaque granular concretions; it has at the apex two lateral horns, from the inner side of which arises a collecting tubule running forward and divided at a preacetabular level into a short anterior and a long posterior branch.

Experiment I. On September 19, 1934, nine cysts were fed to one *Elaphe quadrivirgata*, which had been ascertained to be free of gastro-intestinal trematodes. 42 days later the snake was killed and two immature and one gravid worms were recovered from the stomach. The following measurements in mm are from this gravid specimen fixed in alcohol in a somewhat contracted state, stained with hematoxylin-eosin and mounted in balsam. Body 2.27 × 0.65; preoral lip 0.05; oral sucker 0.25 × 0.26; pharynx 0.15 × 0.15; acetabulum 0.338 in diameter; ovary globular, overlapping acetabulum, 0.14 in diameter; anterior testis globular, 0.2 in diameter; posterior testis ovoid, 0.23 × 0.18; eggs embryonated, 0.084–0.095 × 0.045–0.051.

Experiment II. On May 27, 1935, five cysts and four days later nineteen cysts were fed to one *Elaphe climacophora* (Boie) which had been kept in my terrarium for more than 8 mounths. On June 27 the snake was sacrified and one immature and three gravid worms were found in the stomach. Measurements in mm of the gravid specimens fixed in Schaudinn's solution under slight cover glass pressure gave the following results: Body 2.1–2.8 × 0.75–0.9; preoral lip 0.025–0.038; oral sucker 0.28–0.3 in diameter; pharynx 0.16–0.2 × 0.15–0.18; acetabulum 0.31–0.38 × 0.4–0.42; ovary 0.138–0.175 in diameter; anterior testis 0.16–0.28 × 0.225–0.28; posterior testis 0.25–0.32 × 0.25–0.3; eggs 0.084–0.09 × 0.045–0.051.

" Distoma spec.? juv. " of André, encysted in *Rana esculenta* and *R. temporaria*, apparently belongs to *Encyclometra* Baylis et Cannon, 1924, and probably to *E. colubrimurorum* (Rud., 1819), with which all the described European members of the genus were synonymized by Dollfus.

Fig. 23. Mature *Encyclometra japonica* obtained from Experiment II; ventral view.

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LECITHODENDRIIDAE Odhner, 1910

11. *Pleurogenes japonicus* n. sp.

DESCRIPTION. About a dozen mature worms were found in the small intestine of *Rana nigromaculata* from Fukuoka Prefecture. The nearly elliptical body, 0.56–1.18 mm long by 0.24–0.47 mm broad at about the middle, is covered all over by minute scale-like spines. The subterminal oral sucker, 0.088–0.12 mm in diameter, is followed by a very short prepharynx. The pharynx is 33–42 μ long by 38–57 μ broad. The esophagus, 0.04–0.15 mm long, is usually narrow but may be dilated. The strongly divergent ceca, up to 0.2 mm long, terminate just in front of the testes. The acetabulum, 0.088–0.12 mm in diameter, lies just behind or almost at the middle of the body.

The subglobular testes, 0.068–0.18 × 0.062–0.16 mm, lie anterolateral to the acetabulum, with the posterior end of the cirrus pouch, the distal ascending portion of the uterus and the shell gland complex between. The club-shaped cirrus pouch containing a looped vesicula seminalis, a well differentiated

pars prostatica surrounded by prostatic cells, and a straight ductus ejaculatorius, extends obliquely to the anterior end or the middle of the acetabulum and sometimes as far as the posterior end of the latter. The protrusible cirrus opens directly behind the female aperture into the genital atrium which in turn opens on the left body margin in level with the middle of the esophagus or the intestinal bifurcation.

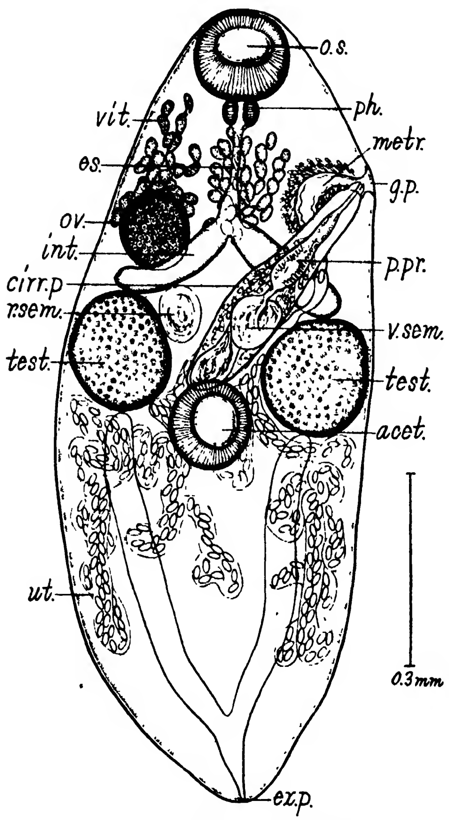

Fig. 24. *Pleurogenes japonicus*; ventral view.

The globular ovary, 50–100 μ in diameter, lies in all the specimens directly outside the right cecum. The germiduct arising from the posteromedial part of the ovary proceeds backwards across the cecum on its dorsal side and after joining the voluminous receptaculum seminis curves round the latter to receive the common vitelline duct and then forms the ootype. The Laurer's canal arises from the receptaculum seminis and opens on the middorsal surface at the level of the acetabulum. The uterus reaching to near the posterior end of the body finally runs along the cirrus pouch to continue into the metraterm, which crosses over the cirrus pouch and then curves toward the genital atrium as in *Pleurogenes claviger* (Rud., 1819) of Looss. The thick coat of Begleitzellen around the metraterm has a gland-like appearance. The elliptical thin-shelled eggs are 27–30 μ long by 14–15 μ broad. The vitellaria form on either side of the esophagus grape-like bunches. The excretory bladder is Y-shaped, with a short stem and opens terminally.

DISCUSSION. This species differs from *Pleurogenes medians* (Olsson) of Looss chiefly in the position of the testes and in the relative position of the metraterm to the cirrus pouch, and from other related ones in which the ceca do not extend into the hindbody, such as *gastroporus* Lühe, 1901, *sphaericus* Klein, 1905, *freycineti* Johnston, 1912, *solus* Johnston, 1912, *stromi* Travassos, 1924, *taylori* Tubangui, 1928, *sitapurii* Srivastava, 1934, etc, in the position of the testes or the genital pore, or in egg size, etc.

Pleurogenes japonicus n. sp.

SPECIFIC DIAGNOSIS. *Pleurogenes* Looss, 1896. Body 0.56–1.18 × 0.24–0.47 mm. Oral sucker 0.088–0.12 mm in diameter. Pharynx 33–42 × 38–57 μ. Esophagus variable in length and width, up to 0.15 mm long when extended. Ceca terminating in front of testes. Acetabulum as large as oral sucker, with its center just behind middle of body. Testes subglobular, nearly symmetrical, anterolateral to acetabulum. Cirrus pouch extending to anterior end or middle of acetabulum or sometimes further backward. Genital pore sinistral, level with middle of esophagus or intestinal bifurcation. Ovary globular, smaller than testes, directly outside right cecum. Metraterm arcuate, opening immediately in front of cirrus. Eggs 27–30 × 14–15 μ.

Habitat. Small intestine of *Rana nigromaculata*.

Locality and date. Fukuoka Prefecture; April 22, 1935.

Type and paratypes in my collection.

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DICROCOELIIDAE Odhner, 1911

12. *Mesocoelium elongatum* Goto et Ozaki, 1929

This trematode, usually parasitic in *Diemyctylus pyrrhogaster*, was found also in the small intestine of *Rana rugosa* Schlegel from Siga Prefecture.

Measurements in mm on four fully mature specimens fixed in alcohol and stained with hematoxylin-eosin gave the following results: Body 2.35–3.2 × 0.5–0.6; oral sucker 0.23–0.29 in diameter; pharynx 0.06–0.078 in diameter; esophagus 0.12–0.2; intestine 0.28–0.36; acetabulum 0.15–0.2 in diameter; testes 0.13–0.17 × 0.1–0.14; ovary 0.16–0.21 × 0.12–0.2; eggs 0.036–0.051 × 0.024–0.028.

The cervical glands are present, though not mentioned by the original authors.

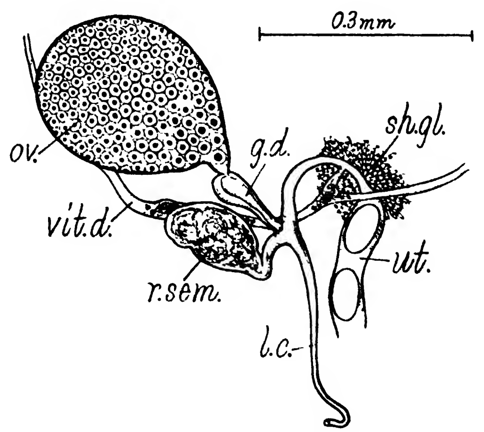

Fig. 25. Ovarian complex of *Mesocoelium elongatum* Goto et Ozaki, 1929; dorsal view.

13. *Mesocoelium brevicaecum* Ochi, 1930

Ochi found this species naturally parasitizing *Bufo vulgaris japonicus* Schlegel, *Elaphe quadrivirgata* (Boie) and *Eumeces latiscutatus* (Hollowell) and obtained adult worms by feeding the metacercariae encysted in *Euhadra quaesita* (Deshayes) to *Bufo vulgaris japonicus*, *Rana nigromaculata*, *R. rugosa* and *R. catesbiana*. So far as the body shape is concerned, her description of the adult worm is more accurate than that by Goto and Ozaki, who unfortunately overlooked the prepharynx.

Six fully mature examples from *Bufo vulgaris japonicus*, as fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam without cover glass pressure gave the following measurements in mm: Body 1.14–2.0 × 0.45–0.73; oral sucker 0.125–0.225 in diameter; pharynx 0.042–0.075 × 0.05–0.087; acetabulum 0.093–0.19 in diameter; testes 0.063–0.12 × 0.063–0.1; ovary 0.063–0.138 × 0.063–0.126.

The embryonated eggs measured 42–48 × 26–30 μ in life.

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Strigeidae Railliet, 1919

14. *Proalarioides serpentis* Yamaguti, 1933

Nine encysted tetracotyle larvae of this worm were found on September 19, 1934, in the breast and thigh muscles of *Rana nigromaculata* from near Kyoto. The cyst is oval, translucent white and has a thin, delicate wall. The contained larvae were easily liberated from the cysts and fixed in alcohol, stained with hematoxylin-eosin and mounted in balsam for microscopical observations.

The body, 1.5–2.5* × 0.8–1.4 mm, is distinctly divided into a broader forebody and a slightly longer hindbody. The cup-shaped terminal oral sucker is 0.12–0.16 mm and the pharynx 0.075–0.1 mm in diameter. The wide ceca extend a little farther backward than the posterior testis. The transversely elongate oval acetabulum is 0.063–0.12 × 0.1–0.16 mm, with its posterior border overlapped by the holdfast organ, which is circular or longitudinally elongate, measures 0.36–0.6 × 0.37–0.53, and has a more or less pronounced median depression. The lateral suctorial pockets and the genital anlagen are well differentiated; the globular median ovary, up to 0.075 mm in diameter, lies at the anterior part of the forebody, directly anterodorsal to the anterior testis;

* This larger worm was fixed in a completely relaxed state, so that the figures are comparatively large.

the two testes lie one behind the other and measure in the larger specimen 0.16–0.225 × 0.2–0.24 mm. The anlagen of the vesicula seminalis and hermaphroditic duct are represented each by a rudimentary canal surrounded by a dense mass of cells lying between the posterior testis and the genital atrium, which opens dorsally near the posterior extremity by a wide transverse slit.

The vitelline anlagen lie under the compact layer of the adhesive gland cells of the holdfast organ. The excretory system is well developed as in the adult.

Experiment. On May 31, 1935, a single cyst was obtained from *Rana nigromaculata* and fed to *Elaphe climacophora* (Boie), which had been ascertained by fecal examination to be free of any gastro-intestinal trematodes. 27 days later the snake was killed and a gravid worm (Fig. 26) was recovered from the small intestine. As fixed in Schaudinn's solution under slight cover glass pressure the worm gave the following measurements in mm. Body 3.25 × 1.625; oral sucker 0.15 × 0.188; pharynx 0.13 × 0.11; acetabulum 0.15 × 0.2; ovary 0.18 × 0.27; anterior testis 0.3 × 0.52; posterior testis 0.36 × 0.55; eggs 0.108–0.114 × 0.054–0.057.

Fig. 26. Gravid *Proalarioides serpentis* obtained experimentally; ventral view.

Abbreviations used in Figures

acet. acetabulum	metr. metraterm
atr. genital atrium	m. h. macrohook
br. cephalic ganglion	m. s. marginal sucker
cirr. cirrus	mth. mouth
cirr. p. cirrus pouch	oc. eye-spot
d. ej. ductus ejaculatorius	o. s. oral sucker
div. diverticle	ov. ovary
es. esophagus	pap. papilla
es. b. esophageal bulb	p. g. post pharyngeal gland cells
ex. arm. excretory arm	ph. pharynx
ex. p. excretory pore	p. ph. prepharynx
g. d. germiduct	p. pr. pars prostatica
gen. int. ductus genito-intestinalis	p. s. posterior sucker
gl. c. gland cell	r. sem. receptaculum seminis
g. p. genital pore	sh. gl. shell gland
l. c. Laurer's canal	sp. sperm
int. intestine	test. testis
m. muscular band	ut. uterus

ut. d. uterine duct
vag. vagina
v. def. vas deferens
v. eff. vas efferens
vit. vitellarium
vit. d. vitelline duct
vit. res. vitelline reservoir
v. sem. vesicula seminalis
v. s. ext. vesicula seminalis externa
v. s. int. vesicula seminalis interna

18. Studies on Japanese Mysidacea

I. Descriptions of New and Some Already Known Species Belonging to the Genera, Neomysis, Acanthomysis and Proneomysis

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(With Text-figures 1–116)

Collected materials of Japanese Mysidacea contain many interesting species and reveal new facts with respect to their taxonomy, distribution and habits. The study of the specimens is in progress and among them so far examined ten species, that is, two belonging to the genus *Neomysis*, four to *Acanthomysis* and four to *Proneomysis*, are dealt with in the present paper. Of these species seven are new to science, one can be identified with certainty as an already known species and the remaining two are doubtful whether they are referable to already known ones or not. All of them are described and figured in minute details for comparison with each other and to clear up some doubtful points in their structure and taxonomic position.

It is my pleasant duty here to express my deep gratitude to Professor Ikusaku Amemiya, by whose suggestion and guidance the present study was undertaken and carried out. I am also indebted to Mr. Kiichi Nakazawa for his kind information given to me as well as valuable specimens placed by him at my disposal. Thanks are due to Mr. Hiroaki Aikawa, Mr. Katuaki Tuzinaga and other gentlemen who all kindly sent me materials for the study.

Genus *Neomysis* Czerniawsky, 1882

Zimmer (1915) amalgamated the genus *Acanthomysis* Czerniawsky (=*Dasymysis* Holt and Beaumont (1900), *Metamysis* Nakazawa (1910), not Sars, *Orientomysis* Derzhavin (1913)) with the genus *Neomysis* Czerniawsky (1882) on the ground that the distinctions between these two genera have been broken down in the light of the species described by Nakazawa and Derzhavin. In the structure of the male pleopods both genera are identical and the only difference between them lies in the antennal scale. In *Neomysis* the antennal scale is very long, with a sharply pointed apex, while in *Acanthomysis* the antennal scale is comparatively short, with a rounded apex.

The numerous species referred to the comprehensive genus of Zimmer may be divided into two groups according to the character of the antennal scale, as follows:

Group I. Antennal scale with an acute spiniform apex.

N. awatchensis (Brandt)
Mysis awatschensis Brandt 1851, Czerniawsky 1882
Syn: *N. nigra* Nakazawa 1910, Tattersall 1921
N. intermedia (Czerniawsky)
Heteromysis intermedia Czernawsky 1882
N. intermedia, Nakazawa 1910
Syn: *N. awatschensis* Tattersall 1921, Derzhavin 1923
N. isaza Marukawa 1928
N. mercedis Holmes 1897
Holmes 1900, Tattersall 1932
N. rayii Murdoch 1885
Syn: *N. toion* Derzhavin 1913
N. integer (Leach)
Mysis integer Leach 1815
Syn: *Mysis vulgaris* Thompson 1828
N. vulgaris Czerniawsky 1882
N. franciscorum Holmes 1900
Hansen 1913, Schmitt 1919
N. mirabilis (Czerniawsky)
Heteromysis mirabilis Czerniawsky 1882
N. kadiakensis Ortmann 1908
Schmitt 1919, Tattersall 1932
N. japonica Nakazawa 1910
N. americana (Smith)
Zimmer 1904
Mysis americana Smith 1874
N. spinosa Nakazawa 1910
N. czerniawskii Derzhavin 1913
Syn: *N. andersoni* Schmitt 1919
N. patagona Zimmer 1907
N. meridionalis Colosi 1924
N. monticelli Colosi 1924

Group II. Antennal scale with a rounded apex.

N. longicornis (Edwards)
Mysis longicornis Edwards 1837
Acanthomysis longicornis, Czerniawsky 1882
Dasymysis longicornis (Edwards), Holt and Beaumont 1900
Syn: *Acanthomysis playdens* Czerniawsky 1882
Acanthomysis spinosissima Czerniawsky 1882
N. sagamiensis (Nakazawa)
Metamysis sagamiensis Nakazawa 1910

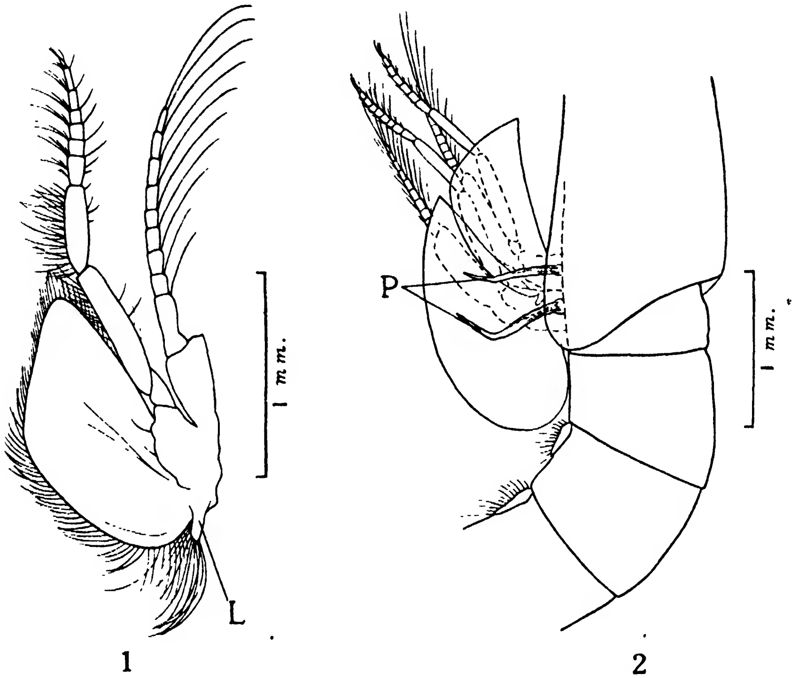
N. mitsukurii (Nakazawa)
Metamysis mitsukurii Nakazawa 1910
N. schrencki (Czerniawsky)
Mysis schrencki Czerniawsky 1882
N. stelleri (Derzhavin)
Orientomysis stelleri Derzhavin 1913
N. costata (Holmes)
Illig 1930, Tattersall 1932
Mysis costata Holmes 1900, Hansen 1913
N. dybowskii (Derzhavin)
Orientomysis dybowskii Derzhavin 1913
N. indica Tattersall 1922
N. hodgarti Tattersall 1922
N. macropsis Tattersall 1932
N. columbiae Tattersall 1933
N. pseudomacropsis Tattersall 1933
N. sculpta Tattersall 1933

As far as I can make out consulting with the keys in Illig's (1930), Tattersall's (1932) and Zimmer's (1909) papers, the present genus, therefore, comprises 28 already known species, as listed above, and is becoming somewhat unwieldy. Therefore, Tattersall inclines to the opinion that it would be better to separate them into two genera according to the character of the antennal scale. In his paper (1932) he says, "it seems probable that Group II will have to be separated generically from the remainder on the character of the antennal scale. It forms a ready means of separating the species into two groups which may well be given generic rank. In such case the name *Acanthomysis* must be used to designate the second group of species." In his later paper (1933) he also says, "When the numerous species belonging to the genus *Neomysis* come to be revised, it will probably be found convenient to group them into a number of closely allied genera." Tattersall, however, in both of his papers (1932, 1933), did not divide the genus *Neomysis* into two genera and adopted Zimmer's arrangement, and it seems that he hesitated before dividing them into two genera and awaited the discovery of some definite distinctions between the two groups beside the character of the antennal scale.

Tattersall in his paper (1932) described interesting facts he observed in the three species belonging to the group I, viz. *N. mercedis* Holmes, *N. franciscorum* Holmes and *N. kadiakensis* Ortmann. The facts, namely, are the following two points which until then had escaped notice. The first point is the presence of a small posterior setose lobe on the posterior pair of oostegites, projecting backward, and rather sharply marked off from the main oostegite. The second point is the presence in the female of a rather long, delicate, somewhat curved and forwardly directed spiniform process on the median line of the last three thoracic sterna.

Especially on these points I examined the five species in my material, viz.

N. japonica Nakazawa, *N. spinosa* Nakazawa, *N. intermedia* (Czerniawsky), *N. czerniawskii* Derzhavin? and *N. nakazawai* n. sp. The results of my examination slightly differ from Tattersall's observation. As to the first point, I found the lobe (Fig. 1) which seems to correspond to that observed and described



Figs. 1–2. *Neomysis intermedia* Czerniawsky

Fig. 1. Seventh thoracic limb with the anterior oostegite to show the posterior lobe (L).

Fig. 2. Middle part of the body to show the processes (P) on the last two thoracic sterna and the marsupial pouch.

by Tattersall to be present on the 'posterior' oostegites in his species. The lobe more or less developed is, on the contrary, on the anterior oostegites in all above named species, and I could not find out any peculiar lobe on the posterior oostegites. Judging, however, from his figure, Tattersall seems to have mistaken the term 'posterior' for 'anterior'. Similar lobe also can be observed in some species belonging to the group II, viz. *N. mitsukurii* (Nakazawa), *N. dybowskii* (Derzhavin)?, *Acanthomysis longirostris* n. sp. and *A. dimorpha* n. sp. As to the second point, I could find such processes (Fig. 2) only on each of the last two thoracic sterna as far as concerned to all my species belonging to the group I except *N. spinosa.* In *N. spinosa* I failed to find such process.

From the above said results of my examination, I think that these two points may or may not be the distinctive characters between the two groups. Further examination is necessary and I reserve here to decide the weight of

these points to count for the generic importance. But at any rate, I believe that the difference in the character of the antennal scale forms a ready means of separating the species into two genera.

In my material I found three new species belonging to the genus *Neomysis* in Zimmer's sense. One of them belongs to the group I, and the other two to the group II. I believe that Japan and her adjacent seas are rich in species of *Neomysis*, and expect that a considerable number of new species may further be discovered hereafter.

Hence, so as not to complicate the genus *Neomysis*, here I separate the group II from the group I generically only on the ground of the difference in the character of the antennal scale and use the name *Neomysis* to designate the group I and *Acanthomysis* the group II.

Neomysis nakazawai[1] n. sp.

Figures 3–13.

LOCALITY. Noda, Karafuto (Sakhalin).

Type specimen. 24 females, no males.

The material was kindly sent to me by Mr. Nakazawa, to whom I am greatly indebted for the privilage of examining and describing the present species.

There are no male specimens in the collection, therefore, the following description is based only on female specimens.

DESCRIPTION. Body stout. Last thoracic somite has 2 rather faint depressions on dorsal side. Anterior 5 abdominal somites have obscure grooves on dorsal side, 3 on the first somite, 2 on each of the second and the third, and 1 on each of the fourth and the fifth.

Front margin of the carapace produced into a wide subquadrangular plate with rounded angles, about $^2/_3$ as long as broad, but the carapace leaves the whole of the eye-stalks and antennules uncovered; front margin of the rostral plate concave with a broad ob-trapezoidal indentation and somewhat depressed at the middle. Antero-lateral corners of the carapace long and acutely pointed.

Eyes, including the stalk, about $1^2/_3$ times as long as broad, cornea occupying about $^1/_3$ of the entire eye in dorsal view.

Antennular peduncle long and slender; basal joint almost as long as the 2 distal joints combined.

Antennal scale long and narrow, about 15 times as long as broad, and about 3 times as long as the antennular peduncle, setose all round, 2-jointed, the distal joint about $^1/_8$ of the entire length of the scale and terminating in an acute spiniform apex; basal joint, from which the scale arises, with a prominent spine on both inner and outer corners.

Antennal peduncle about $^1/_5$ of the length of the scale; the third joint

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[1] In honour of Mr. Kiichi Nakazawa.

slightly shorter than the second.

Mouth parts, first and second thoracic limbs show no feature of special interest.

Third to the eighth thoracic limbs rather slender, propodite divided into 9–15 subjoints which increase in number posteriorly; basal plate of the exopod with a spiniform outer distal angle.

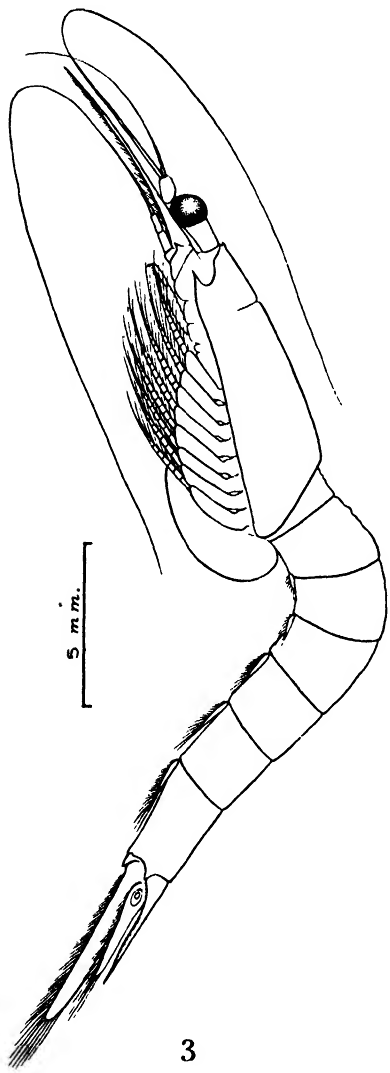

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Fig. 3. *Neomysis nakazawai* n. sp.

Lateral view of adult female.

Marsupial pouch consisted of 2 pairs of oostegites; the posterior margin of the anterior pair of the oostegites with a tiny, setose, backwardly projecting lobe. Each of the last 2 thoracic sterna provided with a long, delicate, spiniform process on the median line.

Sixth abdominal somite about $1\,{}^{1}/_{5}$ times as long as the fifth.

Pleopods of the female are all rudimentary.

Telson linguiform, about $1\,{}^{2}/_{5}$ times as long as the last abdominal somite and about $2\,{}^{4}/_{5}$ times as long as broad at the base; lateral margins concave in the first ${}^{1}/_{3}$ part, convex in the second ${}^{1}/_{3}$ part and then gradually narrowing toward a narrowly rounded apex; the margins densely armed throughout their length with many stout spines; in the proximal ${}^{2}/_{5}$ of the margins the spines are rather widely spaced, in the next half of the margins the spines growing larger posteriorly and grouped into 5–7 sets, each set composed of a large spine followed by 2–5 slightly smaller spines, and in the last ${}^{1}/_{10}$ of the margins around the apex the spines are short, blunt, very closely set and of even size.

Inner uropod slightly shorter than the telson and its ventral inner margin armed with a dense row of about 80 spines.

Outer uropod $1\,{}^{1}/_{2}$ times as long as the telson.

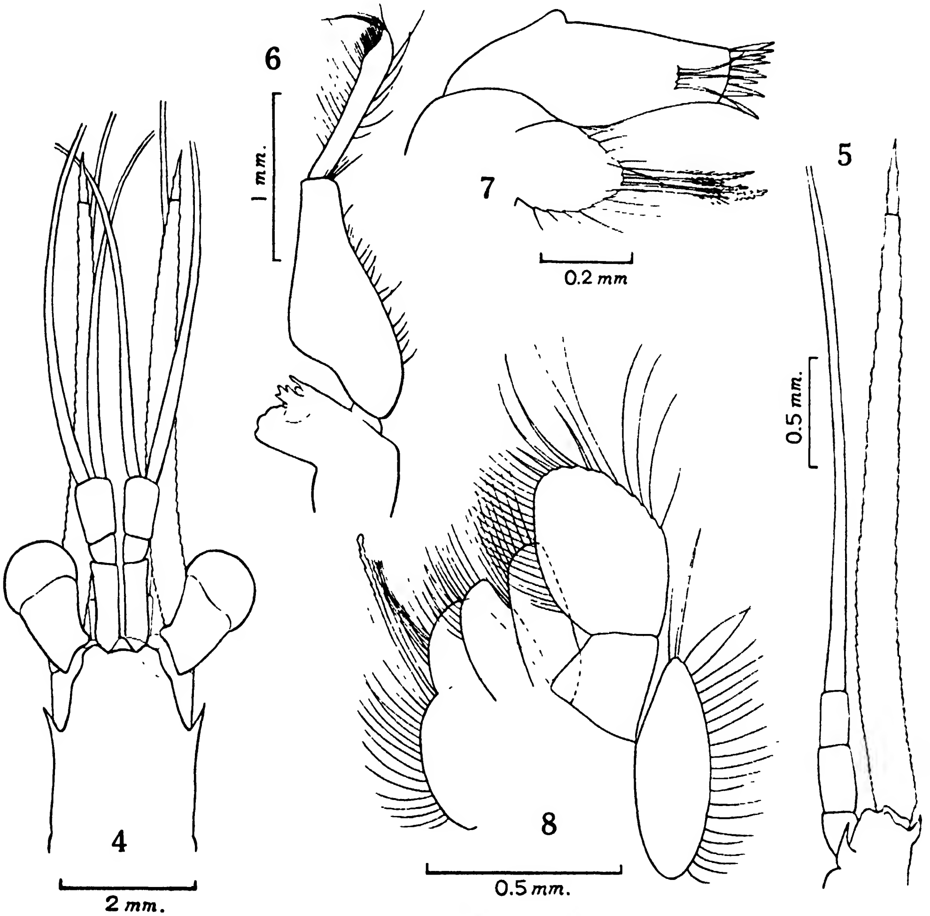
Length. Adult females, 30 mm.

Remarks. Although I could not obtain male specimens, the present species must be included in the genus *Neomysis*, diagnosed clearly by the combination of the characters afforded by the antennal scale, propodite, telson, pleopod

of the female, oostegite, etc.

The present species is very closely allied to *N. patagona* Zimmer, from Magellan Straits, in the peculiar shape of the rostral plate, and easily distinguishable in this point from other species hitherto described. But the present species differs from *N. patagona* in the following points:

(1) Last thoracic somite and anterior 5 abdominal somites have grooves on dorsal side, whereas in *N. patagona* the body is smooth.



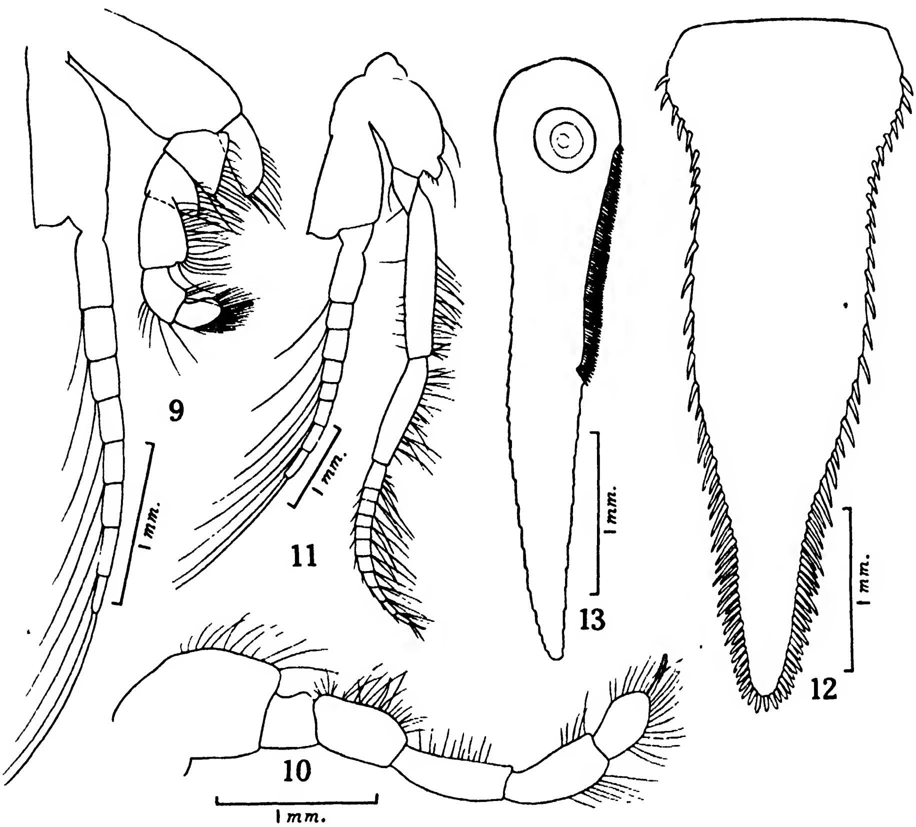
Figs. 4–8. *Neomysis nakazawai* n. sp.

Fig. 4. Anterior end of a female to show rostral plate, eye, antennule and antennal scale.
Fig. 5. Antennale scale and peduncle.
Fig. 6. Mandible and palp.
Fig. 7. First maxilla.
Fig. 8. Second maxilla.

(2) In the present species the rostral plate leaves the whole of the eye-stalks and antennules uncovered, while in *N. patagona* the rostral plate reaches to the middle of the eye-stalks.

(3) Antennal scale is relatively longer, 15 times as long as broad in the present species, while in *N. patagona* it is 9 times as long as broad.

(4) Propodite of the third to the eighth thoracic limbs subdivided into 9–15 joints in the present species and 8–9 in *N. patagona*.



Figs. 9–13. *Neomysis nakazawai* n. sp.

Fig. 9. First thoracic limb.
Fig. 10. Endopod of second thoracic limb.
Fig. 11. One of the posterior thoracic limbs.
Fig. 12. Telson.
Fig. 13. Inner uropod.

(5) The present species is rather easily distinguishable from *N. patagona* in the armature of the telson.

(6) Inner uropod is provided with a dense row of about 80 spines on the ventral inner margin in the present species, while in *N. patagona* with only 1 spine on the same part.

(7) Outer uropod is setose all round, and has no spines not as in *N. patagona*.

Neomysis czerniawskii Derzhavin ?

Figures 14–21.

Neomysis czerniawskii Derzhavin 1913

Neomysis andersoni Schmitt, 1919; Rept. Canad. Arctic Exp. 1913–1918. 7, Crustacea, (B), 1 B–8 B, 3 text-figs.

LOCALITIES. Port Samé, Aomori Prefecture. Abundant, adult males and females.

Off the coast of the Sikotan Peninsula, Hokkaido. Abundant, adult males and females.

Present specimens from the two localities, especially the Sikotan samples agree very well with Derzhavin's description of *N. czerniawskii* in many essential points. But to my regret, as Derzhavin's description is very brief and rather incomplete, and he made no mention about the features of the fourth pleopod of the male in his text, I can not make full comparison of the present specimens with the Derzhavin's. Recently Tattersall united *N. andersoni* Schmitt with *N. czerniawskii* by the examination of Schmitt's co-types. But it is a regret for me unable to say anything about the matter, as I can not consult with Schmitt's original description of *N. andersoni*.

Judging from scrutiny of Derzhavin's figures in his paper the present specimens from the two localities slightly differ from *N. czerniawskii* in the apical armature of the telson. In my specimens the apex of the telson is armed with 4 equally long spines, while in Derzhavin's figure of *N. czerniawskii* the 4 spines show different features, e. i., the inner pair of the spines are shorter than the outer. As to the fourth pleopod of the male of Derzhavin's specimens, I can only cognise vaguely its form and length by his figure of the male. In his figure only tiny fourth pleopod is shown. But I think his figure depicts an immature male with tiny fourth pleopod which has not yet fully grown. Immature males in my specimens from Port Samé, which measure 9 mm. in length also show the same condition as Derzhavin's figure. Thus, it is quite certain that Derzhavin's figure was drawn from some immature specimen. As to the shape of the rostrum Derzhavin gave no description thereof and in his comparison of *N. czerniawskii* with *N. spinosa* Nakazawa he made also no reference to the rostrum, but in my present specimens the rostrum clearly differs from that of *N. spinosa*.

On the other hand, there are slight differences between the Samé and the Sikotan specimens, that is, in the body length of the adult, and in the number of joints of the propodite and in that of the spines on the ventral inner margin of the inner uropod, as are shown in the following table.

However, I think that these differences cannot be considered more than variations in a species, as in many other important characters all these specimens are very similar. It is not seldom occurrence that the number of joints of propodite and that of spines on the ventral inner margin of inner uropod are liable to variations in the same species. Nevertheless, the Samé specimens

	Number of joints of propodite	Number of spines on the ventral inner margin of uropod	Body length
Samé specimen	8–10	44–54	16 mm
Sikotan specimen	9–12	54–60	21 mm
N. czerniawskii (after Derzhavin)	9–12	54	21 mm

show fairly noticeable differences from others, e. i., in the body length and in the number of joints of propodite. Yet, the said differences seem to me also variations in the same species, as these kinds of variations in one species are equally rather common in Mysidacea according to localities and also to different seasons of the year even in the same locality. Therefore, the Samé specimens may be at greatest one variety in the species, the samples of which were collected from Kamchatka (Derzhavin) and Sikotan.

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Fig. 14. *Neomysis czerniawskii* Derzhavin ? Lateral view of adult male.

I am not quite sure yet whether the present specimens actually belong to the same species as that described by Derzhavin or not. Decision on this point can only be made by examination of fully grown specimens of *N. czerniawskii*, or, perhaps, when Schmitt's description of *N. andersoni* is available for reference. So that I reserve here to draw any conclusion on the specific identification of the present specimens for future study. However, from above said reasons and also taking into consideration the hydrographical relation of the three localities where Derzhavin's and my specimens were collected, I am rather inclined to the opinion that my present specimens from two localities are identical with each other and also with *N. czerniawskii* at the same time. And it seems advisable in this opportunity to give a brief description of the Sikotan specimens.

Description. Front margin of the carapace produced into a wide subquadrangular plate with rounded angles, the front margin of the plate somewhat depressed at the apex, so that it appears slightly concave in outline; antero-lateral corners of the carapace acutely pointed.

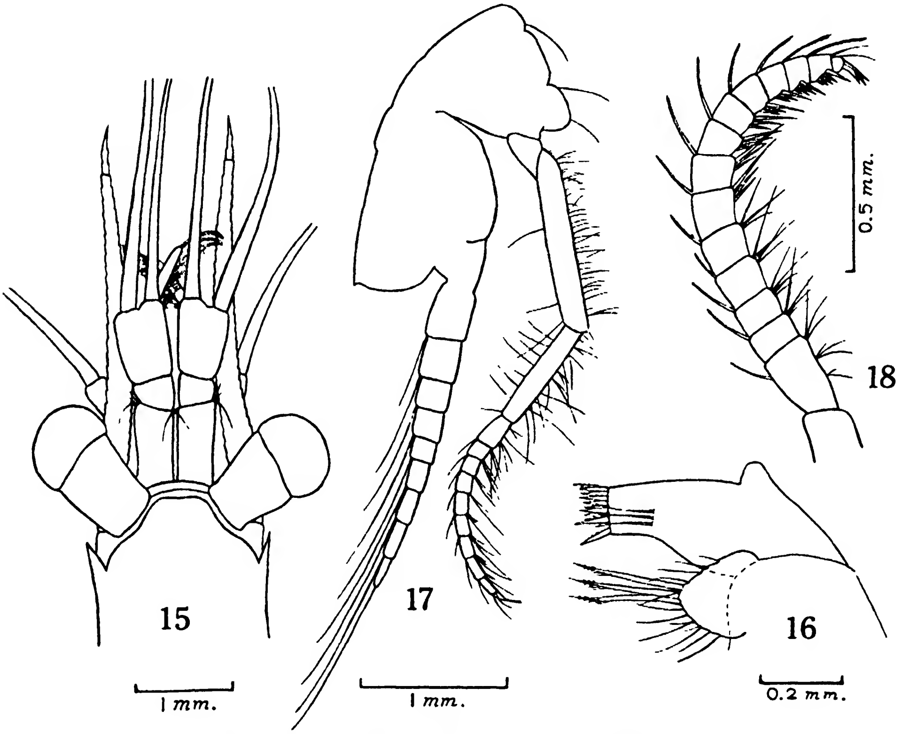
Each of the free somite of the thorax and the 5 anterior abdominal somites with 2 or 3 faint transverse grooves on dorsal side.

Eyes globose, eye-stalks rather long.

Antennular peduncle more robust in the male

than in the female; its first joint provided with 2 long plumose setae, one on the outer distal corner and the other near the inner distal corner; male sexual appendage slender, about as long as the third joint.

Antennal scale narrowly lanceolate in shape with a pointed apex, about 14 times as long as broad, extending far beyond the antennular peduncle, 2–$2^1/_2$ times as long as it, 2-jointed, the distal joint $^1/_6$–$^1/_7$ of the entire length of the scale; the scale somewhat longer in the female than in the male; the second joint of the antennal peduncle slightly longer than the third joint.



Figs. 15–18. *Neomysis czerniawskii* Derzhavin?

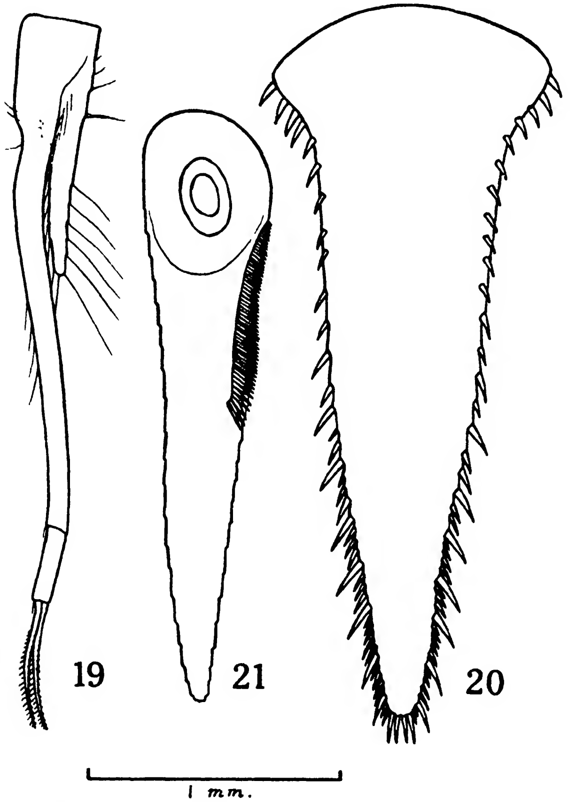
Fig. 15. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.
Fig. 16. First maxilla.
Fig. 17. Third thoracic limb.
Fig. 18. Distal joints of eighth thoracic limb to show the peculiar transformation of the setae along the inner margin of propodite.

Mouth parts, first and second thoracic limbs show no very marked difference from those in other species of the genus.

Third to the eighth thoracic limbs slender; propodite divided into 9–12 joints, the number of the joints increases posteriorly. In the last thoracic limbs setae on the inner margin of distal 5–6 joints of propodite transformed into strong spines.

Fourth pleopod of the male reaching to the middle of the last abdominal

somite, exopod 2-jointed, the first joint about 5 times as long as the second joint, the latter terminated by 2 long spinous setae, about $1^{1}/_{2}$ times as long as the joint.



Figs. 19–21. *Neomysis czerniawskii* Derzhavin ?

Fig. 19. Fourth pleopod of the male.
Fig. 20. Telson.
Fig. 21. Inner uropod.

Telson long and narrowly triangular, about $1^{1}/_{2}$ times as long as the last abdominal somite, and $2^{1}/_{2}$ times as long as broad at the base, abruptly narrowing at a short distance from the base and then gradually narrowing to a slender truncate apex, the proximal $^{2}/_{5}$ of the lateral margins armed with about 15 short, stout and uniform spines, in the distal $^{3}/_{5}$ of the margins spines arranged in 8–10 successive sets, each set being composed of 2–4 small spines followed by a longer and stronger spine, the apex bears 4 equally long spines, which are about as long as the longer lateral spines.

Inner uropod almost as long as the telson, and with a dense row of about 54 spines on the ventral inner margin.

Outer uropod about $1^{1}/_{2}$ times as long as the inner.

Length. Adult specimens of both sexes, 21 mm.

Remarks. The present species is very closely allied to *N. spinosa* Nakazawa, but is distinguishable from it by the shape of the rostrum, by the absence of the spiniform process on the eye-stalk and of the spines on the fifth and the sixth abdominal somites, and by the number of joints on the propodite and of the spines on the inner margin of the inner uropod.

Distribution. Awatschin Bay, Bay of Petropawlowsk, Kamchatka. (Derzhavin, 1913).

Genus *Acanthomysis* Czerniawsky, 1882 emend.

This genus was established by Czerniawsky in 1882 and has been named at various times *Dasymysis* by Holt and Beaumont 1900, *Metamysis* by Naka-

zawa 1910 and *Orientomysis* by Derzhavin 1913. In 1915, Zimmer in his revision of the genera of the tribe Mysini regarded all these genera as synonyms of *Neomysis*, mainly on the basis of the character of the pleopods which are uniform throughout their members.

Afterward numerous species have been referred to the genus *Neomysis*, and thus the genus became very rich in species and somewhat unwieldy. Hence, I have separated the group of species which have the antennal scale with a rounded apex from the genus *Neomysis* and revived the name *Acanthomysis* to designate group II as already discussed under the genus *Neomysis*.

DEFINITION OF THE GENUS. A genus of the tribe Mysini closely allied to *Neomysis*, but is distinguishable from it by the rounded apex of the antennal scale. In other respects the genus absolutely agrees with *Neomysis*.

Type: *A. longicornis* (Edwards).

REMARKS. The present genus is distinguishable from all other genera of the tribe Mysini by the combination of the characters afforded by the antennal scale and the fourth pleopod of the male.

I found 2 species in my material, both new to science. With 13 species already described, the genus will now include 15 species altogether as are shown as follows:

A. longicornis (Edwards) 1837
=*Neomysis longicornis* (Edwards)
A. sagamiensis (Nakazawa) 1910
=*Neomysis sagamiensis* (Nakazawa)
A. mitsukurii (Nakazawa) 1910
=*Neomysis mitsukurii* (Nakazawa)
A. schrencki (Czerniawsky) 1882
=*Neomysis schrencki* (Czerniawsky)
A. stelleri (Derzhavin) 1913
=*Neomysis stelleri* (Derzhavin)
A. costata (Holmes) 1900
=*Neomysis costata* (Holmes)
A. dybowskii (Derzhavin) 1913
=*Neomysis dybowskii* (Derzhavin)
A. indica (Tattersall) 1922
=*Neomysis indica* Tattersall
A. hodgarti (Tattersall) 1922
=*Neomysis hodgarti* Tattersall
A. macropsis (Tattersall) 1932
=*Neomysis macropsis* Tattersall
A. columbiae (Tattersall) 1933
=*Neomysis columbiae* Tattersall
A. pseudomacropsis (Tattersall) 1933
=*Neomysis pseudomacropsis* Tattersall
A. sculpta (Tattersall) 1933
=*Neomysis sculpta* Tattersall

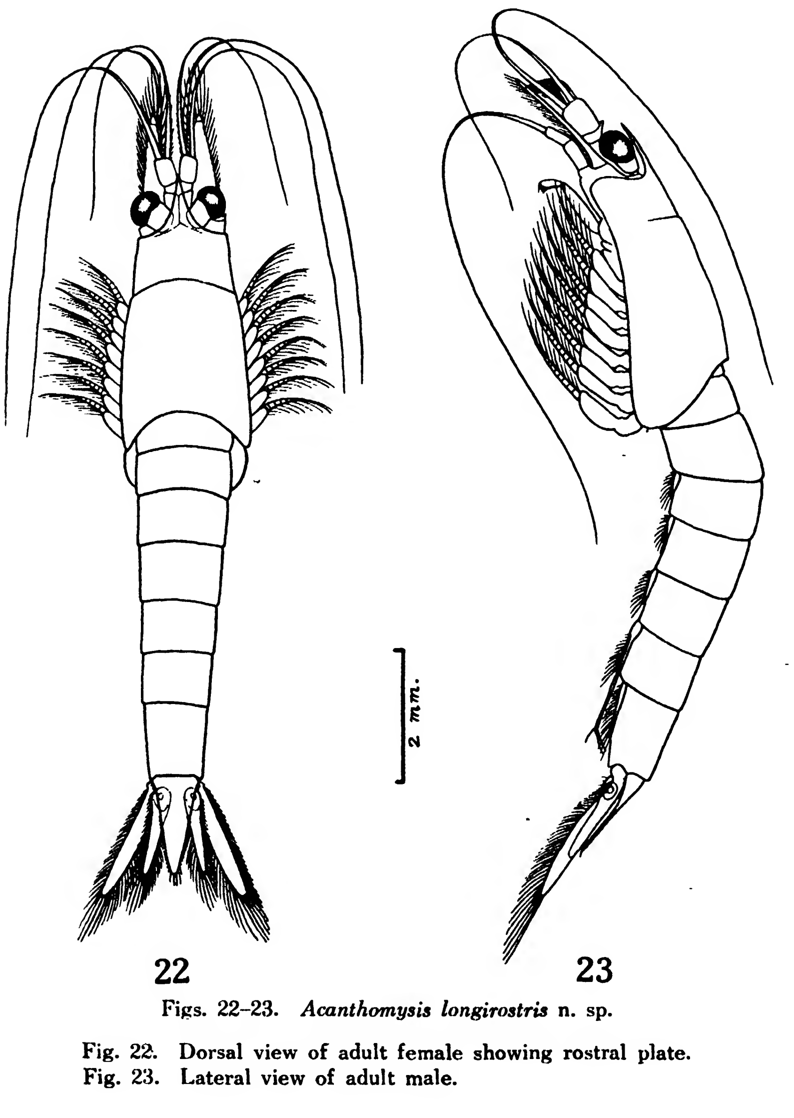
A. longirostris n. sp.
A. dimorpha n. sp.

Acanthomysis longirostris n. sp.

Figures 22–32.

LOCALITIES. Port Gunzan, Tyôsen (Korea).
Type specimen. Abundant, adult males and females.
Ariake Sea, Kyûshû. 22 males, 8 females.

DESCRIPTION. Body smooth, without spinules or grooves on either thorax or abdomen.



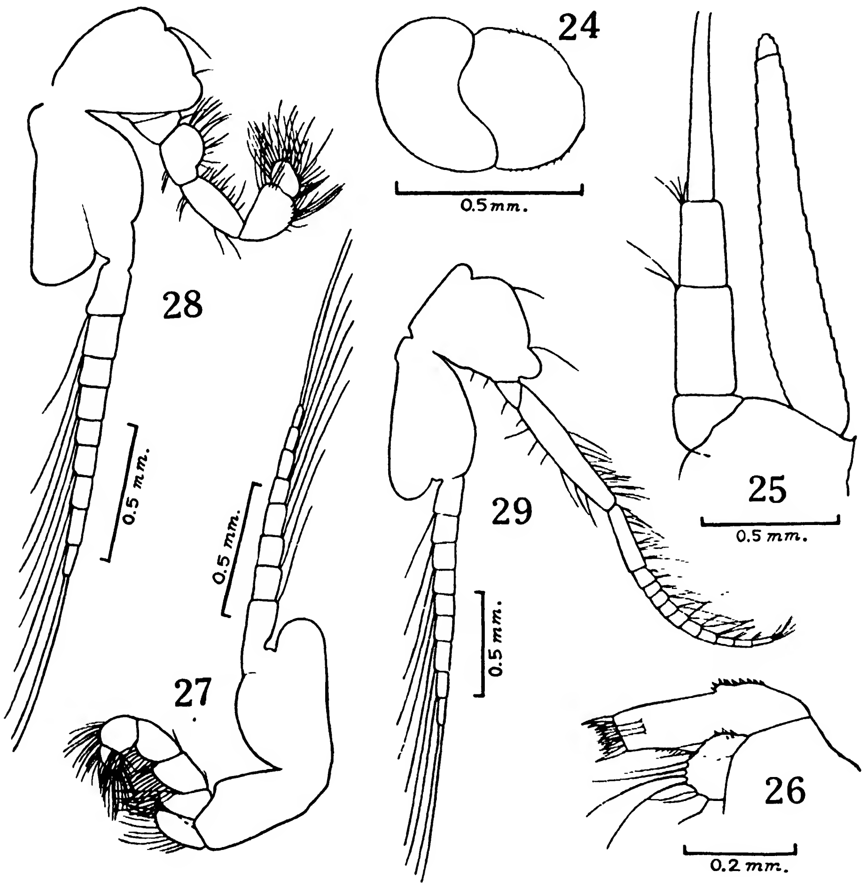
Figs. 22–23. *Acanthomysis longirostris* n. sp.

Fig. 22. Dorsal view of adult female showing rostral plate.
Fig. 23. Lateral view of adult male.

Front margin of the carapace produced into a long triangular rostral plate with a sharply pointed apex, the apex reaches to the distal end of the second joint of the antennular peduncle; antero-lateral corners of the carapace rounded.

Eyes normal in shape, pigment black; eye-stalk stout and its proximal half densely beset with spinules.

Antennular peduncle with the first joint slightly shorter than the third joint; male sexual appendage long, triangular and about half as long as the third joint.



Figs. 24–29. *Acanthomysis longirostris* n. sp.

Fig. 24. Eye.
Fig. 25. Antennal scale and peduncle.
Fig. 26. First maxilla.
Fig. 27. First thoracic limb.
Fig. 28. Second thoracic limb.
Fig. 29. One of the posterior thoracic limbs.

Antennal scale narrowly lanceolate in shape, about 7 times as long as broad, apex rounded, 2-jointed, the distal joint about $^1/_{15}$ of the entire length of

the scale; the scale extends for $^2/_5$ of its length beyond the antennular peduncle and its own peduncle, and slightly longer in the female than in the male.

Labrum pointed anteriorly and the spine reaching to the middle of the second joint of the palp of mandible.

First maxillae with a ridge on the outer margin of the outer plate armed with about 10 spinules; outer margin of the inner plate also armed with several spinules.

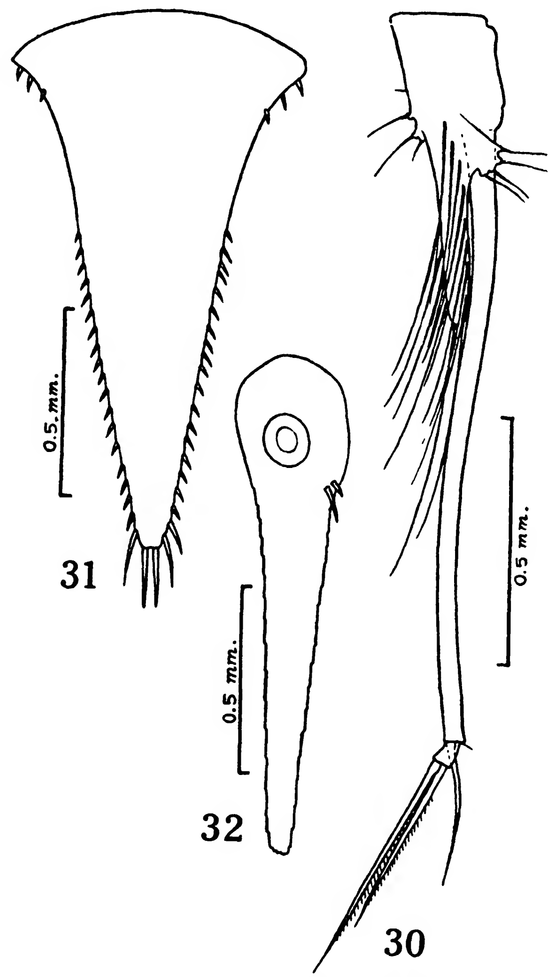
Second maxillae, first and second thoracic limbs show no features of special interest.

Remaining thoracic limbs with propodite divided into 9–11 (mostly 10) joints; meropodite longer than carpopodite.

The sixth abdominal somite $1^1/_3$ times as long as the fifth.

Fourth pleopod of the male reaching almost to the posterior end of the last somite of the abdomen; endopod of usual form; exopod 2-jointed; the first joint very long and its inner distal corner armed with a long simple seta, about $^1/_4$ of the length of the joint; the second joint very short, only $^1/_{22}$ of the length of the first joint and terminated by 2 long spinous setae about 8 times as long as the joint.

Telson long, triangular, $1^1/_3$ times as long as the last abdominal somite, and almost twice as long as broad at the base, abruptly narrowing at a short distance from the base and then almost straightly narrowing to a slender but truncate apex; lateral margins armed with about 23 small spines, 3 of them situated near the base and the others on the distal $^3/_5$ of the margins; the last pair of lateral spines abruptly increasing in length, almost as long as a pair of spines on the apex, which are about $^1/_{10}$ of the



Figs. 30–32. *Acanthomysis longirostris* n. sp.

Fig. 30. Fourth pleopod of the male.
Fig. 31. Telson.
Fig. 32. Inner uropod.

length of the telson.

Inner uropod slightly longer than the telson, with 2–3 spines on the lower inner margin near statocyst; statocyst rather small.

Outer uropod about $^1/_3$ longer than the telson.

Length. Adult males and females, 11 mm.

REMARKS. The present species is very closely allied to *A. hodgarti* (Tattersall). But it differs from *A. hodgarti* in the following points:

(1) The rostral plate is much longer than that of *A. hodgarti*, the apex sharply pointed and reaches to the distal end of the second joint of the antennular peduncle.

(2) Propodite of the third to the eighth thoracic limbs subdivided into 9–11 joints in the present species and 5 6 joints in *A. hodgarti*.

(3) Superficially, telson is very much similar to that of *A. hodgarti*, but the apex more narrowly truncated than in *A. hodgarti*, and slightly differs in the apical armature. In *A. hodgarti* the apex bears 4 equally long spines, while in the present species the apex bears only 2 long spines, yet it looks very much alike the same part of *A. hodgarti*, if it is seen together with the last pair of the lateral spines.

(4) In this species the exopod of the fourth pleopod of the male has very short second joint, about $^1/_{22}$ of the length of the first joint and terminated by 2 long spinous setae; while in *A. hodgarti* the second joint $^2/_7$ of the length of the first joint and terminated by a long simple seta.

Tattersall described the fourth pleopod of the male in *A. hodgarti* as follows: "Fourth pleopod reaching almost to the base of the telson, endopod with well developed side lobe, exopod composed of three joints, first joint very long, three and a half times as long as the second, latter bearing a very long straight simple seta three times as long as the joint, terminal joint very minute with a single short seta at the apex." However, I cannot find out the tiny third joint in his small figure. If his description is correct, I think these structures of the fourth pleopod of the male do not conform to the generic character of the genus *Acanthomysis*.

The present species is also closely allied to *A. longicornis* (Edwards) and *A. sagamiensis* (Nakazawa), but easily distinguishable from both of them by several features e. i., the rostral plate, the number of joints of the propodite of the thoracic limbs, the fourth pleopod of the male and the armature of the telson.

Long rostral plate and the form of the fourth pleopod of the male will serve to distinguish the present species from any hitherto known species in the genus.

Acanthomysis dimorpha n. sp.

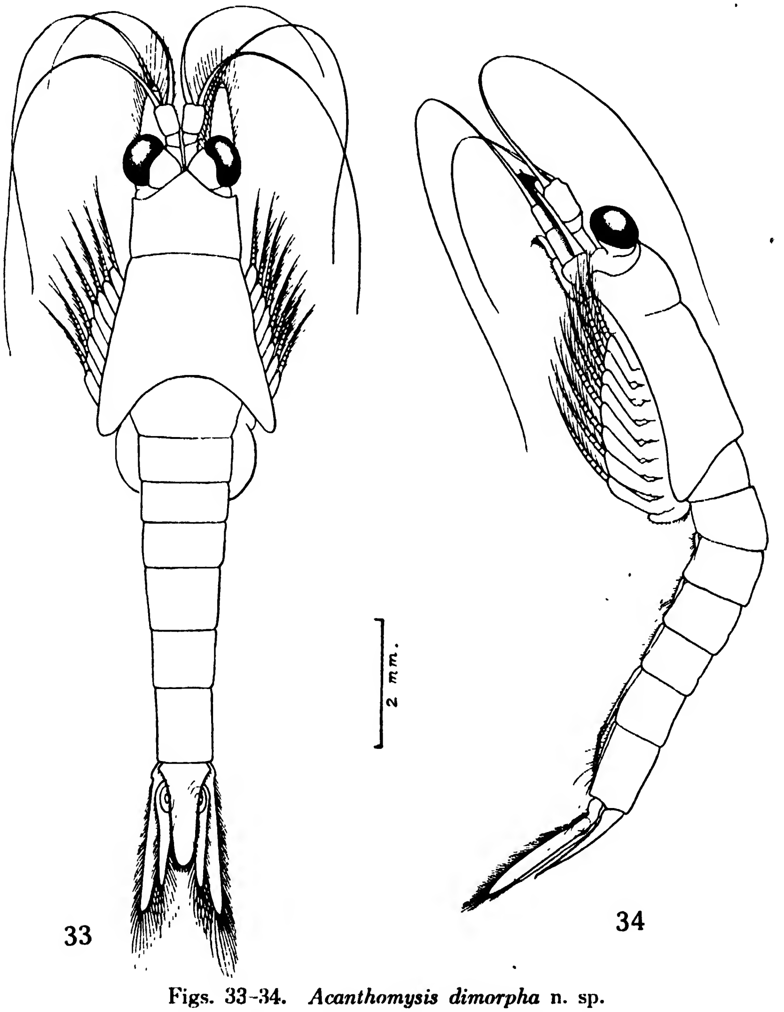
Figures 33–46.

LOCALITY. Off Urusan, Korea Straits.

Type specimen. 26 males, 22 females.

Description. Front margin of the carapace produced into a short triangular rostral plate, apex obtusely pointed; antero-lateral corners of the carapace rounded.

Eyes large, slightly depressed in lateral view, in dorsal view the whole eye is about as long as broad and the cornea about half as long as the entire length of the eye.



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Figs. 33–34. *Acanthomysis dimorpha* n. sp.

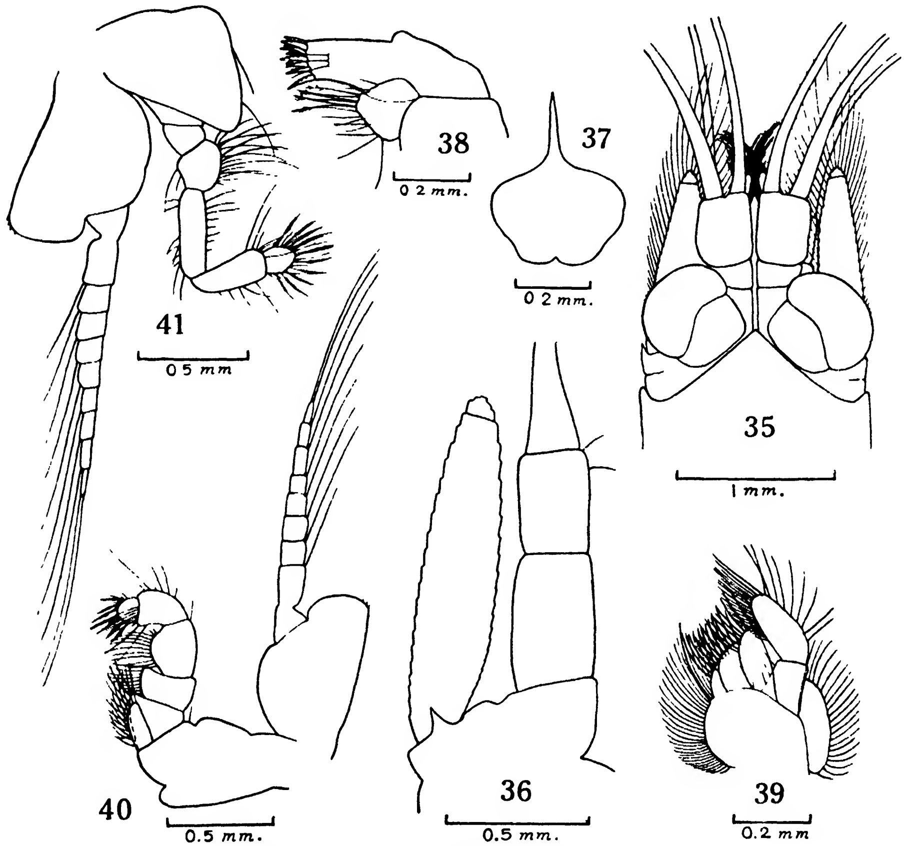
Fig. 33. Dorsal view of adult female. Fig. 34. Lateral view of adult male.

Antennular peduncle short and stout, in the male the third joint almost as long as the 2 proximal joints combined, male sexual appendage well developed and triangular in shape; in the female the third joint shorter than the 2 proximal joints combined.

Antennal scale slightly longer than the antennular peduncle, in the male

the scale extends to the distal end of the male sexual appendage, about 4 times as long as broad, apex rounded, 2-jointed, the distal joint $^1/_{11}$ of the entire length of the scale; basal joint, from which the scale arises, with a prominent spine on the outer distal corner. Antennal peduncle slightly shorter than the antennular peduncle.

Mouth parts, first and second thoracic limbs show no very marked difference from those in other species of the genus.



Figs. 35–41. *Acanthomysis dimorpha* n. sp.

Fig. 35. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.
Fig. 36. Antennal scale and peduncle.
Fig. 37. Labrum.
Fig. 38. First maxilla.
Fig. 39. Second maxilla.
Fig. 40. First thoracic limb.
Fig. 41. Second thoracic limb.

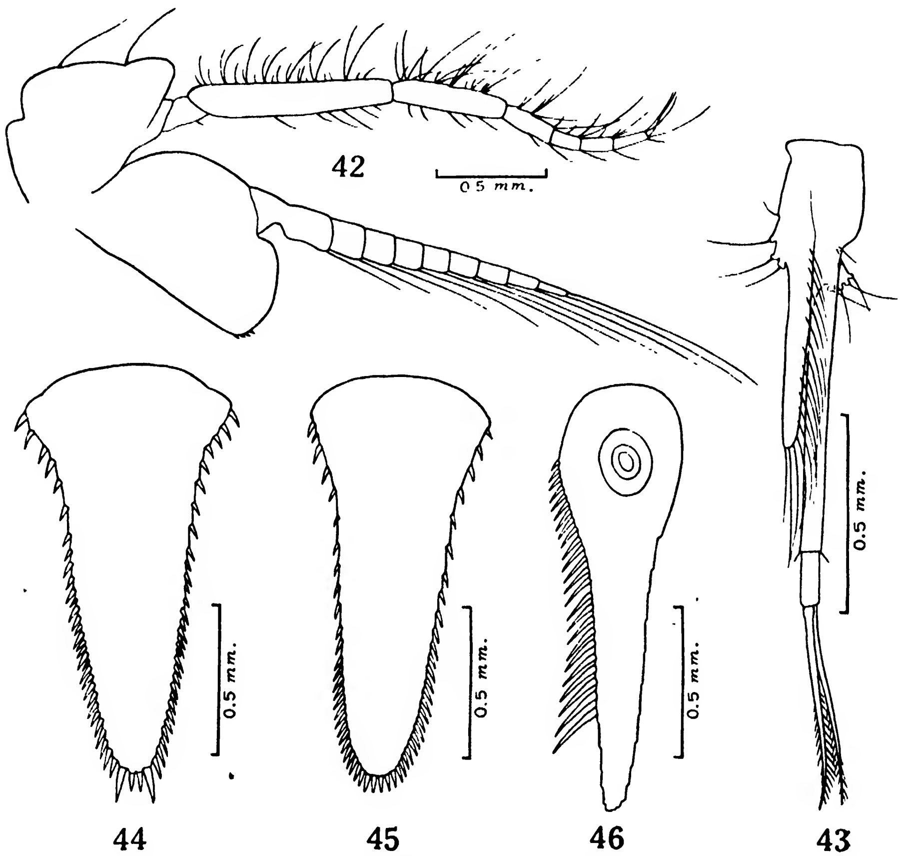
Third to the eighth thoracic limbs slender, propodite divided into 4–5 joints. Basal plate of the exopod of all thoracic limbs with 1–6 small spines on the outer distal corner.

Sixth abdominal somite about $1^2/_5$ times as long as the fifth.

Fourth pleopod of the male extending backwards beyond the middle of

the last abdominal somite; endopod of usual form; exopod 2-jointed, the first joint about $1^{1}/_{2}$ times as long as the endopod and 6 times as long as the second joint, terminal setae about 4 times as long as the second joint.

Telson about $1^{1}/_{2}$ times as long as the last abdominal somite and about twice as long as broad at the base. In the male telson is triangular, lateral



Figs. 42–46. *Acanthomysis dimorpha* n. sp.

Fig. 42. One of the posterior thoracic limbs.
Fig. 43. Fourth pleopod of the male.
Fig. 44. Telson of the male.
Fig. 45. Telson of the female.
Fig. 46. Inner uropod.

margins armed throughout their whole length with about 30 short spines, rather widely spaced proximally and more crowded distally; apex narrowly truncate and armed with 2 pairs of spines, the outer pair stout and longer than the inner and lateral spines, the inner pair equal in size to the lateral spines. In the female telson is linguiform, apex broadly rounded, spines on the lateral margins absolutely identical with those of the male, but spines around the blunt apex are short, closely set and equal in size to the lateral spines, and there can be seen no stout long spines not as in the male.

Inner uropod $1\,{}^{1}/_{6}$ times as long as the telson, the inner margin armed with a row of about 24 slender spines extending from the statocyst almost to the ${}^{3}/_{4}$ point from the base, the spines are regularly set and gradually growing longer toward the apex.

Outer uropod $1\,{}^{1}/_{4}$ times as long as the inner.

Length. Adult males and females, 12 mm.

REMARKS. The present species is unique among the genus *Acanthomysis* in the fact that the male differs from the female in the shape and armature of the telson, in addition to the usual secondary sexual characters.

The present species is distinguishable from all other species of the genus by the peculiar row of spines on the ventral inner margin of the inner uropod which somewhat recalls that of the genus *Doxomysis*.

Acanthomysis dybowskii (Derzhavin) ?

Figures 47-55.

Orientomysis dybowskii, Derzhavin 1913

LOCALITY. Off Urusan, Korea Straits. 6 males, 24 females.

The present specimens are in substantial agreement with Derzhavin's description and his figures of *Orientomysis dybowskii*. However, I am not sure whether they belong actually to the same species as that described by Derzhavin or not, because his description and figures are too imperfect to allow a full comparison with my specimens.

There is nothing in his description that can not be applied to my specimens, yet beside the characters noted by him the present specimens have 2 points of importance which may be regarded as the additional specific characters. The first point is the presence of the spiniform process on the eye-stalk and the second is the presence of the peculiar setae on the carpopodite and the propodite of the third to the eighth thoracic limbs. Judging from his obscure figure, there may be slight difference in the form and armature of the telson. As to the fourth pleopod of the male he gives no description, but in his remarks he says "Von allen andern Arten dieser Gattung unterscheidet sich ***Orientomysis dybowskii*** durch ihre langen Pleopoden und die breit-zungenförmige Gestalt ihres Telsons." However, in my specimens, the fourth pleopod of the male is not specially long as compared with

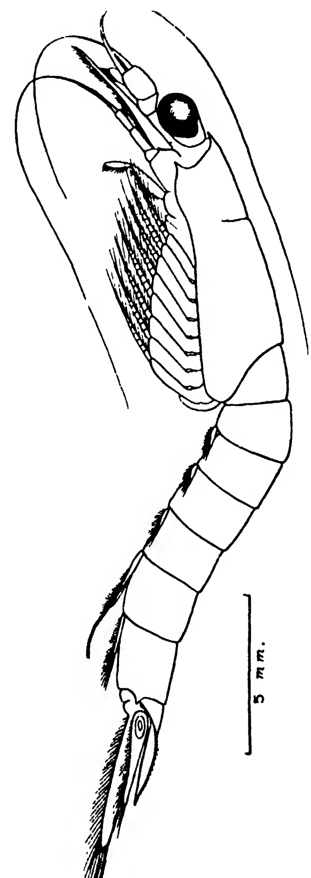


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Fig. 47. *Acanthomysis dybowskii* (Derzhavin)?

Lateral view of adult male.

that in other species of the genus.

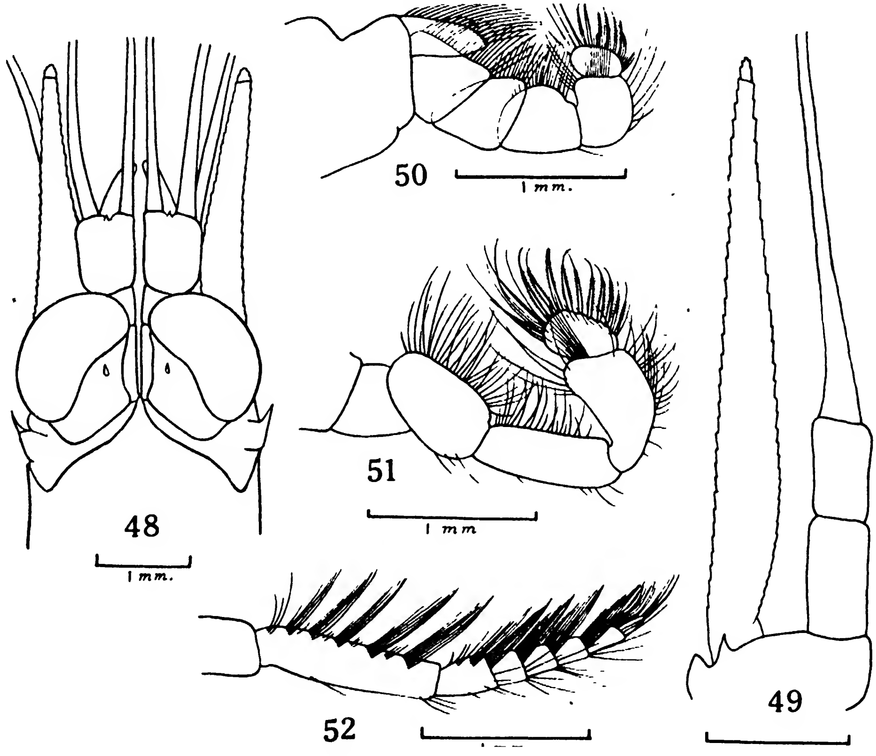
Here I describe and figure my specimens for the convenience of future reference.

Description. Front margin of the carapace produced into a triangular rostral plate, angle of the apex acute but the tip bluntly pointed; antero-lateral corners of the carapace acutely pointed.

Eyes, including the stalk, about as long as broad; cornea reniform and occupying about $^2/_3$ of the entire eye in dorsal view; the stalk with a blunt spiniform process on dorsal side just as in *N. spinosa* Nakazawa.

Antennular peduncle with the first joint almost as long as the third joint, male sexual appendage triangular in dorsal view.

Antennal scale long and narrow, about 8 times as long as broad, apex narrowly rounded, 2-jointed, the distal joint about $^1/_{25}$ of the scale in length; the scale in the male slightly shorter than twice of the antennular peduncle



Figs. 48–52. *Acanthomysis dybowskii* (Derzhavin)?

Fig. 48. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.
Fig. 49. Antennal scale and peduncle.
Fig. 50. Endopod of the first thoracic limb.
Fig. 51. Endopod of the second thoracic limb.
Fig. 52. Distal joints of one of the posterior thoracic limbs.

but in the female slightly longer than twice of the same.

Mouth parts, first and second thoracic limbs show no marked difference from those in other species of the genus.

Third to the seventh thoracic limbs with propodite divided into 5 joints, the eighth limbs always with a larger number (7) of joints than the preceding limbs; carpopodite armed with about 6 series of long setae along its inner margin, each series consisted of 3–10 setae arranged sideways; inner distal corner of each joint of propodite also armed with a single series of similar setae. Basal plate of the exopod of all thoracic limbs with 3 or 4 small spines on the outer distal corner.

Fourth pleopod of the male extending backwards beyond the middle of the last abdominal somite; endopod of usual form; exopod 2-jointed, the first joint twice as long as the endopod and about 6 times as long as the second joint, the outer distal corner of the first joint armed with a plumose seta which is slightly longer than the second joint, terminal setae about 3 times as long as the second joint.

Telson long linguiform, $1^4/_5$ times as long as the last abdominal somite, and $2^1/_3$ times as long as broad at the base, lateral margins armed throughout their whole length by many slender spines, in the proximal $^1/_3$ of the margins the spines rather widely spaced but in the distal $^2/_3$ grouped into about 9 sets, each set composed of a large spine followed by 2–6 small spines, apex rounded and armed with 2 pairs of spines, the inner pair shorter than the outer pair and about as long as the shorter lateral spines.

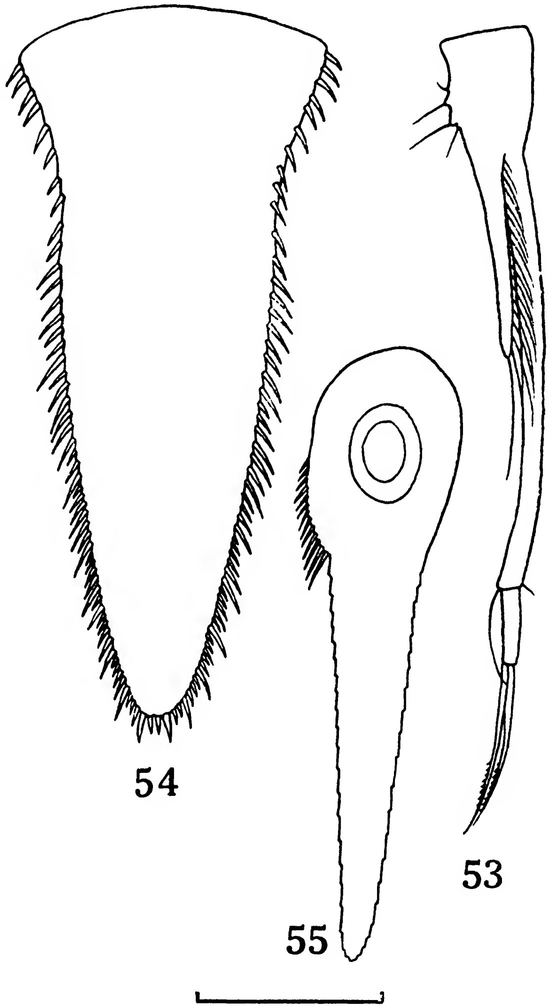


Fig. 53–55. *Acanthomysis dybowskii* (Derzhavin)?

Fig. 53. Fourth pleopod of the male.
Fig. 54. Telson.
Fig. 55. Inner uropod.

Inner uropod almost as long as the telson, with about 13 spines on the inner margin near statocyst.

Outer uropod $1^{2}/_{5}$ times as long as the telson.

Length. Adult males and females, 25 mm.

REMARKS. The present species is distinguishable from all other species in the genus by the combination of characters afforded by the shape and armature of the telson and by the presence of the spiniform process on the eye stalks and of the peculiar setae on the carpopodite and propodite of the thoracic limbs.

DISTRIBUTION. Awatschin Bay, Bay of Petropawlowsk, Lake Kultutschnoje (Derzhavin, 1913).

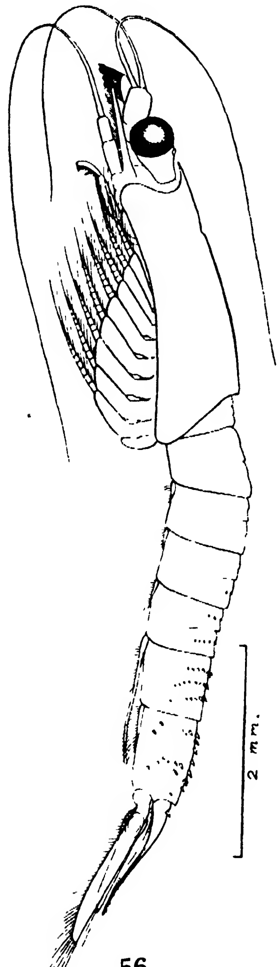


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Fig. 56. *Acanthomysis mitsukurii* (Nakazawa) Lateral view of adult male.

Acanthomysis mitsukurii (Nakazawa)

Figures 56-66.

Metamysis mitsukurii Nakazawa 1910

LOCALITY. Aziro, Sizuoka Prefecture. Abundant males and females.

The present specimens agree absolutely with Nakazawa's description and figures of *Metamysis mitsukurii*. In my specimens, however, I found 2 points which seem apparently to be overlooked by Nakazawa. The one point is the presence of a blunt spiniform process on the eye-stalk, and the other is the presence of a pair of spines on the dorsal surface of the telson. Upon questioning on these two points Mr. Nakazawa very kindly answered me that he had overlooked these points. There are also some respects inadequate in his description and figures as to the abdominal somites and the fourth pleopod of the male.

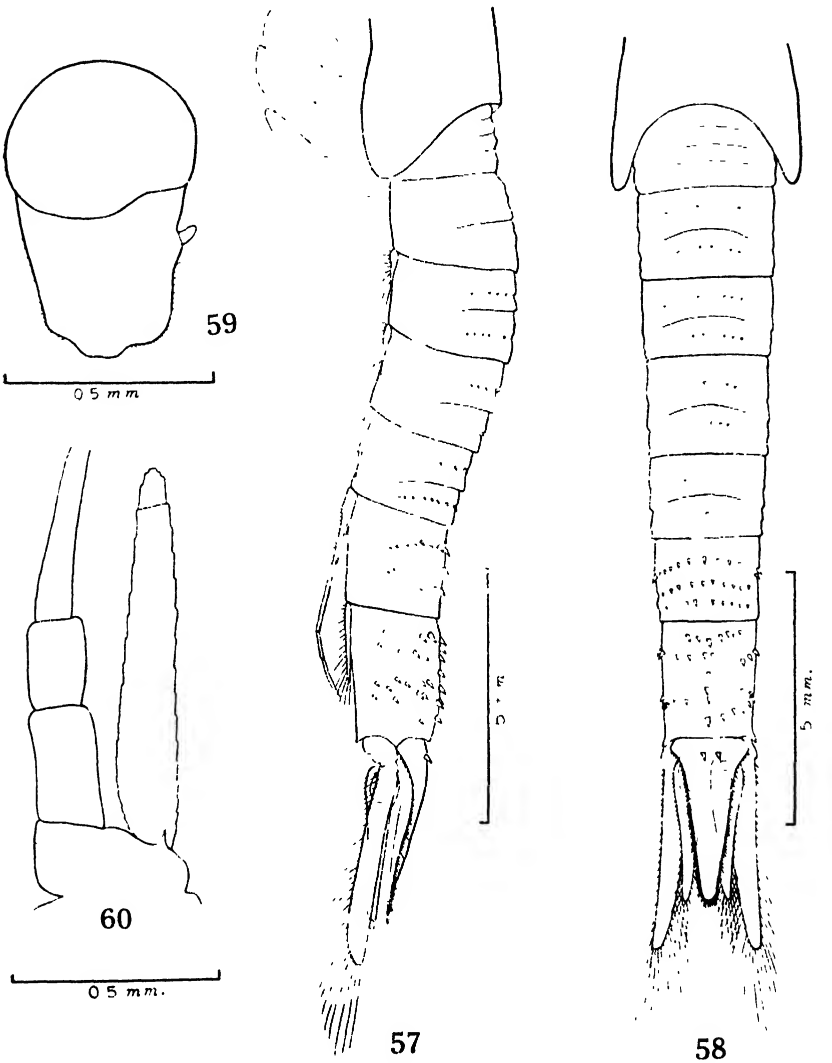
Hence, here again I describe and figure the present species by my own specimens to complete the description of *A. mitsukurii*.

DESCRIPTION. Front margin of the carapace produced into a short triangular rostral plate with a pointed apex; antero-lateral corners of the carapace rounded.

Last thoracic somite with 2 or 3 transverse ridges on dorsal side.

Each of the first to the fourth abdominal somites with a transverse fold in the middle and 2 transverse rows of short spines, one in front and the other behind of the fold; in the anterior abdominal

somites the rows of spines very obscure and appear as if they were faint folds. Each of the fifth and the sixth somites armed with many short but stout spines on the dorsal and lateral surface; the spines on the fifth somite



Figs. 57–60. *Acanthomysis mitsukurii* (Nakazawa)

Fig. 57. Posterior half of a male, lateral view to show the ridges and the rows of spines on the abdominal somites.
Fig. 58. The same, dorsal view.
Fig. 59. Eye, lateral view to show the spiniform process on the stalk.
Fig. 60. Antennal scale and peduncle.

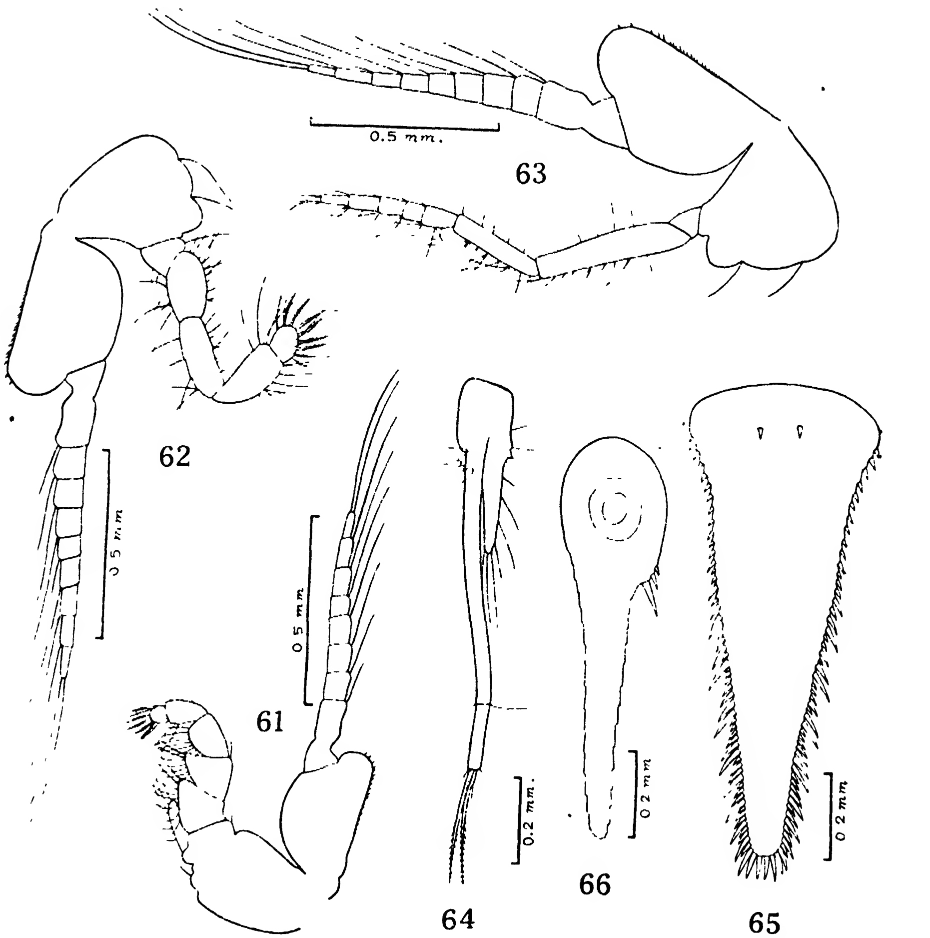
are arranged in 3 transverse rows, the spines on the sixth somite rather scattered and are not in orderly arrangement and there are about 7 spines along

its dorsal median line, as are shown in the figs. 57 and 58.

Eyes, including the stalk, about $1^2/_3$ times as long as broad, cornea occupying slightly less than half of the entire eye in dorsal view; the stalk densely beset with spinules in the proximal half and provided with a blunt spiniform process on dorsal side just as in *N. spinosa* Nakazawa.

Antennular peduncle stouter in the male than in the female; the third joint slightly shorter than the 2 proximal joints combined; male sexual appendage triangular and about half as long as the third joint.

Antennal scale slightly longer than the antennular peduncle, about 6 times as long as broad, apex rounded, 2-jointed, the distal joint about $^1/_{13}$ of the entire length of the scale. Basal joint, from which the scale arises, with



Figs. 61-66. *Acanthomysis mitsukurii* (Nakazawa)

Fig. 61. First thoracic limb.
Fig. 62. Second thoracic limb.
Fig. 63. One of the posterior thoracic limbs.
Fig. 64. Fourth pleopod of the male.
Fig. 65. Telson.
Fig. 66. Inner uropod.

a spine on the outer distal corner.

Labrum provided with a long spiniform process, the tip reaches to the end of the middle joint of the mandibular palp.

Other members of the mouth parts, and first and second thoracic limbs show no marked difference from those of other species in the genus.

Third to the eighth thoracic limbs with propodite divided into 5 joints. Basal plate of the exopod of all thoracic limbs armed with many small spines along the outer margin.

Fourth pleopod of the male long, reaching almost to the posterior end of the last abdominal somite; endopod of usual form; exopod 2-jointed, the first joint about $2^1/_2$ times as long as the endopod and about 4 times as long as the second joint, terminal setae about twice as long as the second joint.

Telson long triangular, $1^1/_2$ times as long as the last abdominal somite and $2^1/_2$ times as long as broad at the base; lateral margins densely armed throughout their length with many stout spines, in the first $^1/_3$ part of the margins the spines short and rather widely spaced, in the remaining part of the margins the spines grouped into about 8 sets, each set composed of a large spine followed by 1-6 small spines; apex narrowly rounded and armed with about 7 subequally long spines which are about as long as the larger spines on the lateral margins; the telson, beside the usual armature, provided with a pair of spines on dorsal surface near the base.

Inner uropod almost as long as the telson, with 3 spines on the inner margin near statocyst.

Outer uropod about $1^1/_4$ times as long as the telson.

Length. Adult males and females, 8 mm.

REMARKS. The present species is easily distinguishable from all other species in the genus by the fact that the abdominal somites are spinulated. The blunt spiniform process on the eye-stalk and the pair of spines on the dorsal surface of the telson may be regarded as additional specific characters, especially the latter.

Superficially, the present species is very closely allied to *N. spinosa* Nakazawa, but it is easily distinguishable from the latter by the shape of the antennal scale.

DISTRIBUTION. Off Ôarai, Ibaraki Prefecture; Off Maisaka, Sizuoka Prefecture (Nakazawa, 1910).

Genus *Proneomysis* Tattersall, 1933 sensu ampl.

The genus *Proneomysis* was originally established by Tattersall for a single species, *P. wailesi*, obtained in the waters of Western Canada.

In my collection I have found 4 species which are all new to science and closely allied to *P. wailesi*. These species, however, differ in one important point from Tattersall's definition of the genus *Proneomysis*. In his *Proneomysis* the fifth pleopod of the male is not similar to that of the female, but well

developed and modified, consisting of a long protopod terminating in a very long seta, while in all my present species the fifth pleopod of the male is absolutely similar to that of the female as in other genera of the tribe Mysini.

Tattersall in his diagnosis of *Proneomysis* attaches great importance to the structure of the fifth pleopod observed in the male of *P. wailesi* and is of the opinion that the character is sufficient to separate *Proneomysis* from other genera of the tribe Mysini. As Tattersall pointed out, if the structure of the fifth pleopod of the male is a character of generic importance, the present 4 species cannot be referred to *Proneomysis*.

In other respects, however, these present species agree absolutely with the characters of Tattersall's *Proneomysis*, especially in the form and character of the fourth pleopod of the male.

In view of this fundamental agreement among this group of species, I naturally raise the question as to the value of the structure of the fifth pleopod of the male in *P. wailesi* for the character of generic importance.

Hence, as Tattersall's *Proneomysis* comprises only a single species, I think that in the present extent of our knowledge it is better to include other species in the genus *Proneomysis*, modifying Tattersall's diagnosis of the genus and defining *Proneomysis* as a genus characterized by the constant character of the fourth pleopod of the male, not taking the peculiar character of the fifth pleopod of the male into account of generic importance.

New Definition of the Genus *Proneomysis*. First, second and third pleopods of the male rudimentary, unjointed and of the same form as in the female.

Fourth pleopod of the male biramus; inner ramus unjointed; outer ramus long and 3-jointed, the last joint terminated into 2 strong spinous setae.

Fifth pleopod of the male either similar or not to that of the female; when not similar, well developed and modified, consisting of a long protopod terminating in a very long seta.

Antennal scale narrowly lanceolate in shape, 2-jointed and setose all round; apex rounded.

Female with 2 pairs of oostegites.

Telson entire, without cleft on the distal end.

Type: *P. wailesi* Tattersall.

Remarks. The present genus is most closely allied to *Acanthomysis*, which, as already described, I have separated from the genus *Neomysis*, and the only real difference between the present genus and *Acanthomysis* lies in the character of the fourth pleopod in the male. The 3-jointed fourth pleopod of the male, with 2 long terminal setae, will serve to distinguish the present genus from other genera in the tribe Mysini.

Key to species of the genus *Proneomysis*

I. Fifth pleopod of the male not similar to that of the female, well developed and modified, consisting of a long protopod terminating in a very long seta. *P. wailesi* Tattersall

II. Fifth pleopod of the male similar to that of the female.
  A. Abdominal somite with transverse fold on dorsal side. *P. misakiensis* n. sp.
  B. Abdominal somite smooth.
    a. Propodite of the third to the eighth thoracic limbs armed with many peculiar setae in comb-like arrangement along the inner margin. *P. eriopedes* n. sp.
    b. Propodite normal and without peculiar setae.
      i. Rostrum long, triangular with a sharply pointed apex, extending beyond the middle of the first joint of the antennular peduncle. *P. fusca* n. sp.
      ii. Rostrum short triangular with an obtusely pointed apex. *P. perminuta* n. sp.

Proneomysis fusca n. sp.

Figures 67–79.

LOCALITY. Misaki, Kanagawa Prefecture.

Type specimen. Abundant, males and females.

Quite common in the vicinity of the Misaki Marine Biological Station. Most abundant in the growth of Sargassum.

DESCRIPTION. In the female, body is stout and coloured dark yellowish-brown except outer flagellum of antennule, flagellum of antenna, mouth parts, appendages on thorax and abdomen, and distal part of uropods. The body colour well matches that of Sargassum. But in the male, body is rather slender and transparent for the most part, and the dark yellowish-brown pigments develop only along the ventral median line of the body.

Front margin of the carapace is produced into a long triangular rostral plate with a sharply pointed apex, the apex in the male reaching to the middle of the first joint of the antennular peduncle and in the female to the posterior end of the same joint; antero-lateral corners of the carapace rounded.

Eyes short and stout with the stalks slightly longer than the cornea.

Antennular peduncle stout in both sexes, the first joint in the male slightly shorter as compared with that in the female; male sexual appendage about $^3/_4$ of the length of the third joint.

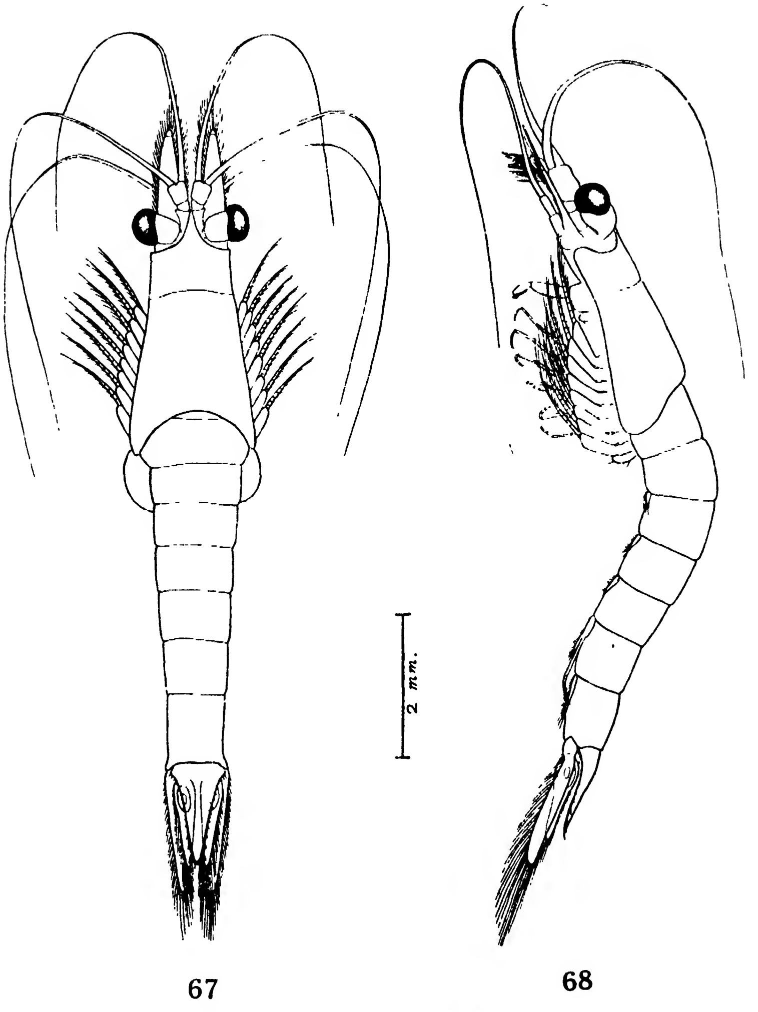
Antennal scale in the male 6 times as long as broad, only slightly longer than the antennular peduncle and extends beyond the antennal peduncle for about $^1/_3$ of its own length; distal joint about $^1/_{12}$ of the entire length of the scale. In the female the antennal scale much larger than in the male, $5^1/_3$ times as long as broad, extending beyond the antennular peduncle for about $^2/_5$ and the antennal peduncle for about $^3/_4$ of its own length; distal joint about $^1/_{16}$ of the entire length of the scale. Basal joint, from which the scale arises, with a prominent spine on the outer distal corner.

Antennal peduncle reaches to the middle of the third joint of the anten-

nular peduncle; the third joint $^{3}/_{4}$ of the length of the second joint.

Labrum provided with a forwardly directed spiniform process.

Mouth parts, first and second thoracic limbs not showing any striking difference from those in *Neomysis* and *Acanthomysis*.



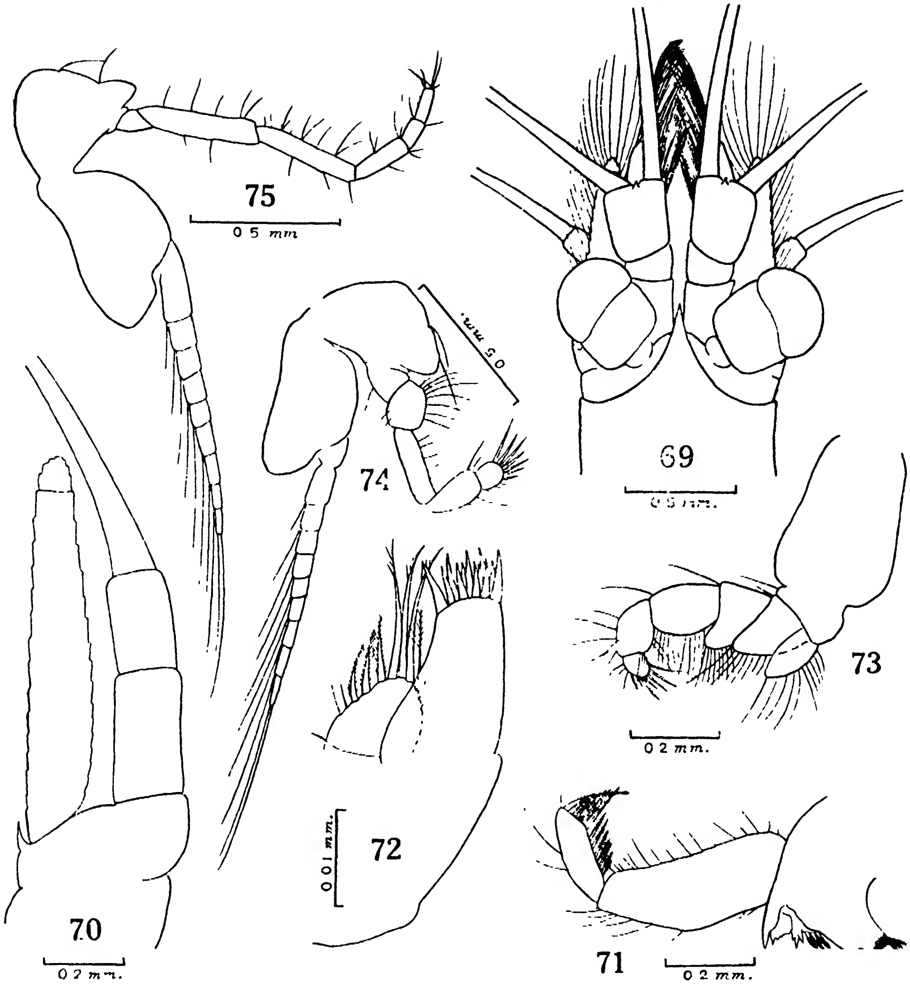
67 68

Figs. 67 68. *Proneomysis fusca* n. sp.

Fig. 67. Dorsal view of adult female. Fig. 68. Lateral view of adult male.

Third to the eighth thoracic limbs rather slender; propodite divided into 3 joints.

Fourth pleopod of the male reaching to the middle of the last abdominal somite; exopod 3-jointed, the first joint about twice as long as the endopod, the second and the third joints almost equal in size and about $^{1}/_{6}$ of the length of the first, the third joint terminated by 2 strong spinous setae, about $2^{1}/_{2}$



Figs. 69–75. *Proneomysis fusca* n. sp.

Fig. 69. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.
Fig. 70. Antennal scale and peduncle.
Fig. 71. Mandible and palp.
Fig. 72. First maxilla.
Fig. 73. Endopod of the first thoracic limb.
Fig. 74. Second thoracic limb.
Fig. 75. One of the posterior thoracic limbs.

times as long as the joint.

Telson triangular in shape, narrowing to a truncate apex which is about $^{1}/_{8}$ the width of the base; in the male the telson is about $1^{2}/_{5}$ times as long as the last abdominal somite, and about $1^{3}/_{4}$ times as long as broad at the base; but in the female the telson is slightly longer than in the male, about $1^{1}/_{2}$

times as long as the last abdominal somite and twice as long as broad at the base; proximal half of the lateral margins armed with about 8 short spines, 3 or 4 spines near the base rather long; distal half of the margins armed

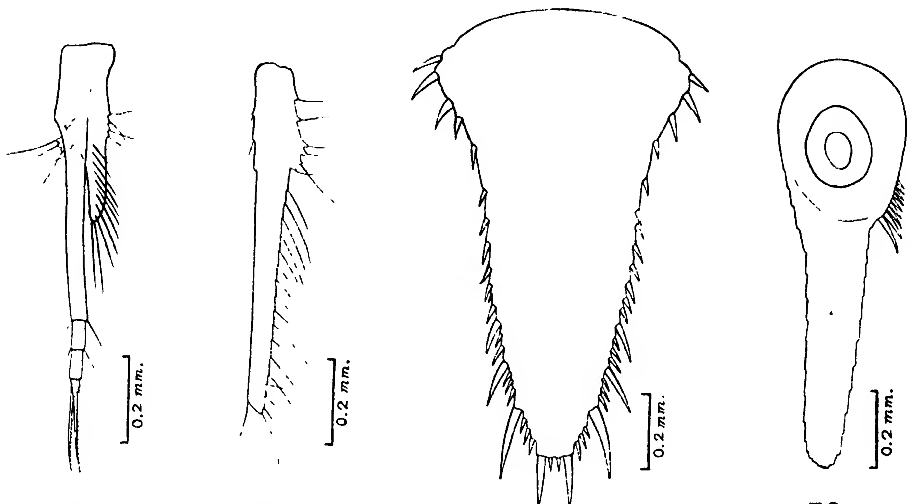


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Fig. 76–79. *Proneomysis fusca* n. sp.

Fig. 76. Fourth pleopod of the male. Fig. 77. Fifth pleopod of the male. Fig. 78. Telson. Fig. 79. Inner uropod.

with 5-6 sets of spines, each set composed of a large spine followed by 2–6 small ones, the larger spines growing larger posteriorly, the last pair of large spines about $^1/_6$ of the total length of the telson; apex armed with 2 pairs of spines, the larger outer pair about $^1/_9$ of the total length of the telson, and the smaller inner pair equal in size to the smaller spines on the lateral margins.

Inner uropod slightly longer than the telson, with 8–9 strong spines on the ventral inner margin near the statocyst; the statocyst rather large.

Outer uropod $^1/_3$ longer in the male and $^1/_4$ longer in the female than the telson.

Length. Adult males and females, 9–10 mm.

Remarks. The present species is very closely allied to *P. eriopedes*, but easily distinguishable from it by the absence of peculiar setae on the inner margin of the propodite.

The long rostral plate will serve to distinguish this species from all other species of the genus.

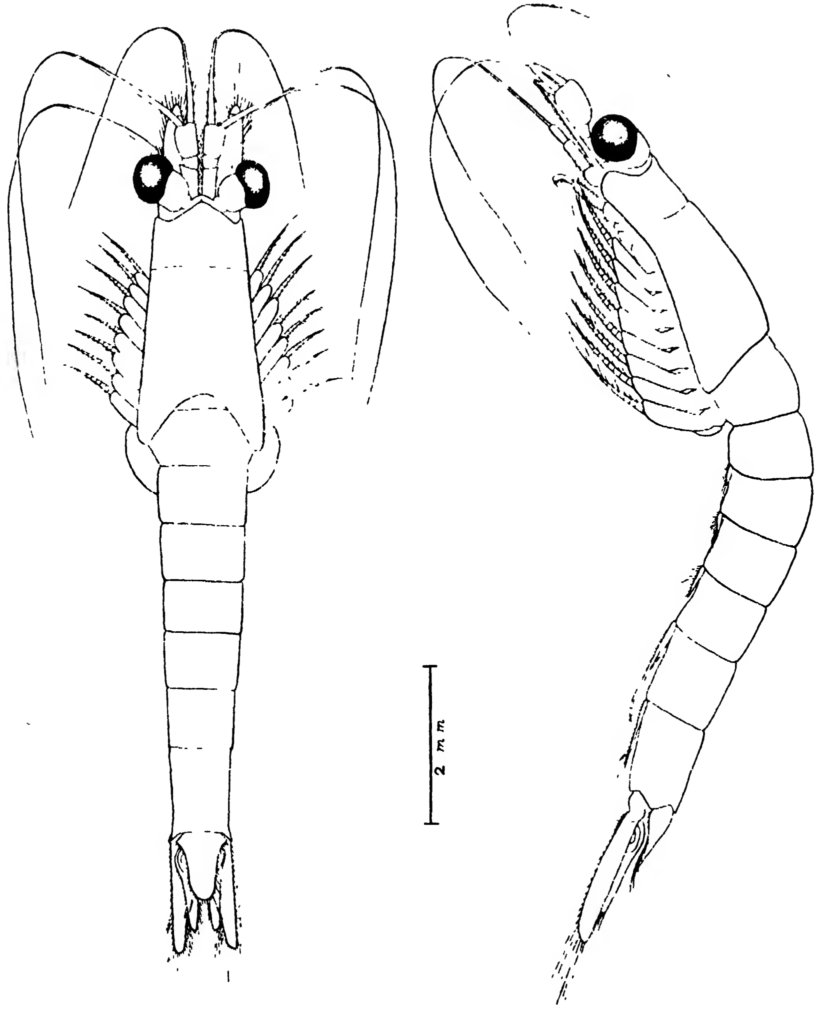
Proneomysis eriopedes n. sp.

Figures 80–92.

LOCALITY. Misaki, Kanagawa Prefecture.

Type specimen. Abundant, males and females.

Common in the growth of sea-weeds in the vicinity of the Misaki Marine Biological Station.



80 81

Figs. 80–81. *Proneomysis eriopedes* n. sp.

Fig. 80. Dorsal view of adult female. Fig. 81. Lateral view of adult male.

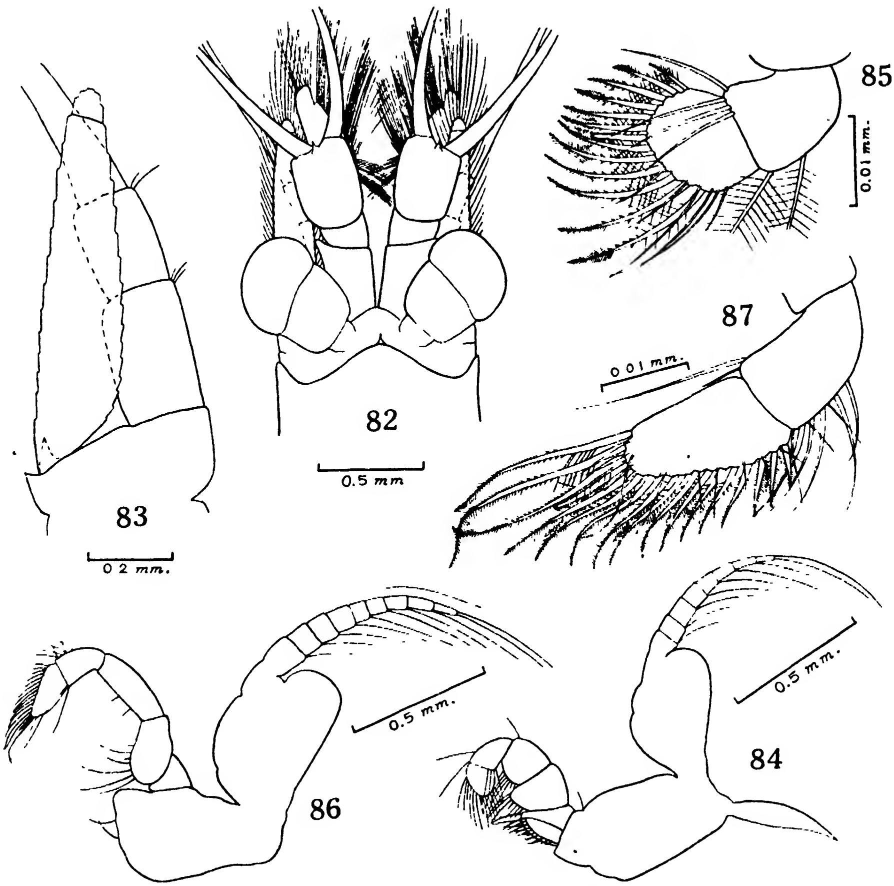
DESCRIPTION. Front margin of the carapace produced into a short triangular rostral plate with an obtuse apex, just under the apex there is a tiny chitinous

projection, which is spiniform in dorsal view; antero-lateral corners of the carapace rounded.

Eyes stout with the stalks slightly longer than the cornea.

Antennular peduncle stout; male sexual appendage well developed and about $^5/_6$ of the length of the third joint of the antennular peduncle. In the female the antennular peduncle somewhat more slender than in the male.

Antennal scale slightly longer than the antennular peduncle and about $4\text{–}4^1/_2$ times as long as broad; distal joint marked off by a very obscure suture and $^1/_{11}\text{–}^1/_{10}$ of the entire length of the scale. Basal joint, from which the scale arises, with a prominent spine on the outer distal corner.



Figs. 82–87. *Proneomysis eriopedes* n. sp.

Fig. 82. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.
Fig. 83. Antennal scale and peduncle.
Fig. 84. First thoracic limb.
Fig. 85. Distal joints of the endopod of the first thoracic limb.
Fig. 86. Second thoracic limb.
Fig 87. Distal joints of the endopod of the second thoracic limb.

Antennal peduncle in the male slightly longer than $^{2}/_{3}$ of the length of the scale, but in the female about half as long as the scale.

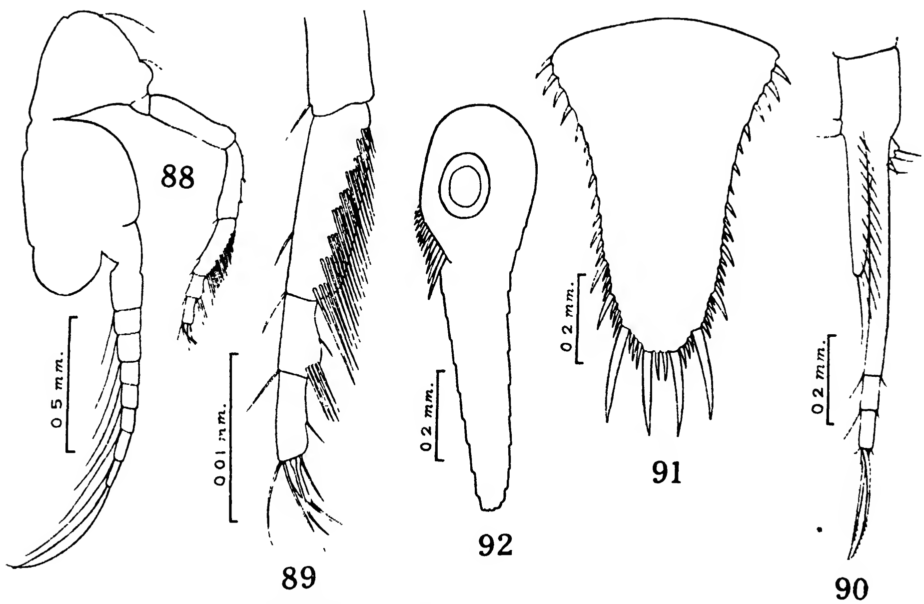
Mouth parts exhibit no feature of special interest.

First thoracic limbs with dactylopodite armed around its distal margin with about 12 stout peculiar plumose setae; hairs on the plumose seta very fine and closely set in the distal part of the seta, but rather stout and widely spaced in the proximal part, between these two parts the seta armed with tiny dentiform spines on each side.

Second thoracic limbs with well developed triangular dactylopodite, which is about twice as long as broad and whose inner margin also armed with about 20 setae identical with those on the dactylopodite of the first thoracic limbs.

Third to the eighth thoracic limbs rather slender; propodite divided into 3 joints; the first joint almost as long as the 2 distal joints combined, its inner margin armed with many setae throughout its whole length, the setae grouped into about 9 series, each series consisted of 3-5 setae arranged sideways; anterior 1 or 2 limbs always with a less number of such series of setae than the other limbs; the second joint of prododite armed with a single series of similar setae on the inner distal corner.

Fourth pleopod of the male reaching to the middle of the last abdominal somite; exopod 3-jointed, the first joint about $1^{1}/_{2}$ times as long as the endopod,



Figs. 88–92. *Proneomysis eriopedes* n. sp.

Fig. 88. One of the posterior thoracic limbs.
Fig. 89. Distal joints of the endopod of one of the posterior thoracic limbs.
Fig. 90. Fourth pleopod of the male.
Eig. 91. Telson.
Fig. 92. Inner uropod.

the second and the third joints almost equal in size and about $^1/_7$ of the first, the third joint terminated by 2 strong spinous setae, about 3 times as long as the joint.

Telson slightly shorter than the last abdominal somite, linguiform, somewhat abruptly narrowing in the first $^1/_3$ part, then gradually narrowing to a broadly rounded apex; proximal half of the lateral margins armed with about 10 short spines, 3–4 spines near the base rather stout and long; distal half of the margins armed with 4–5 sets of spines, each set composed of a large spine followed by 1–5 small spines; the larger spines rapidly grow larger posteriorly, the ultimate and the penultimate pairs of them especially long and about $^1/_4$ of the length of the telson, the shorter spines increase in number posteriorly; on the middle of the apex there are 2 short spines between the ultimate pair of the longer spines.

Inner uropod $1^1/_2$ times as long as the telson, with about 13 spines on the ventral inner margin near the statocyst.

Outer uropod $1^5/_6$ times as long as the telson.

Length. Adult males and females, 9–10 mm.

REMARKS. The present species is very closely allied to *P. fusca* but differs from it in having peculiar setae on the thoracic limbs and in the shape of the rostrum and the telson.

It is distinguishable from all other species of the genus by the presence of the peculiar setae on the thoracic limbs.

Proneomysis misakiensis n. sp.

Figures 93–105.

LOCALITY. — Mouth of Aburatubo Inlet, Kanagawa Prefecture.

Type specimen. Abundant, adult males and females.

Common in the growth of sea-weeds in the vicinity of the Misaki Marine Biological Station.

DESCRIPTION. Front margin of the carapace produced into a triangular rostral plate, the apex extending as far forward as the base of the antennular peduncle, angle of the apex acute, but the tip bluntly rounded; antero-lateral corners of the carapace rounded.

The last thoracic somite with 2 or 3 transverse grooves on dorsal side.

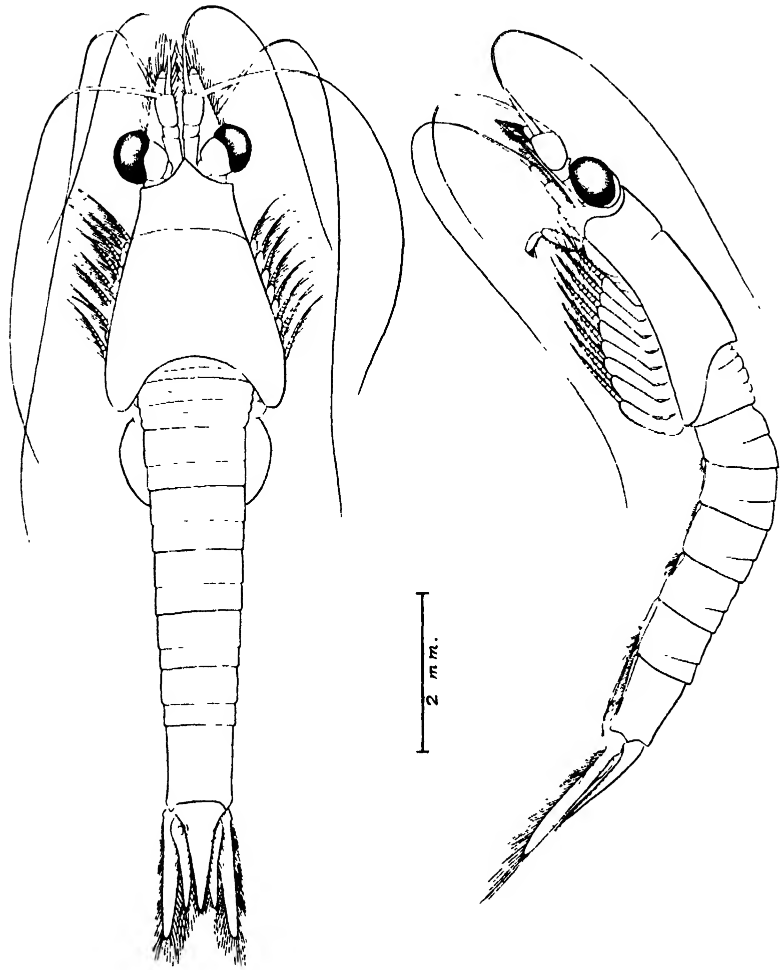
Each of the five anterior abdominal somites with a transverse fold on dorsal side. The fifth abdominal somite always with brown pigments developing along the fold and the distal end of the joint.

Eyes stout and about as long as broad; cornea large and reniform in dorsal view; eyestalk slightly shorter than the cornea and minutely hispid in the proximal half.

Antennular peduncle rather stout; the third joint almost as long as the 2 proximal joints combined; male sexual appendage about half as long as the third joint.

Antennal scale about 5 times as long as broad; distal joint marded off by an obscure suture and about $^1/_{10}$ of the scale in length. In the male the anten-

nal scale extending as far forward as to the distal end of the male sexual appendage and beyond the antennal peduncle for about $^2/_5$ of its own length. In the female the scale slightly larger than in the male, about $1^1/_2$ times as



93 94

Figs. 93–94. *Proneomysis misakiensis* n. sp.

Fig. 93. Dorsal view of adult female. Fig. 94. Lateral view of adult male.

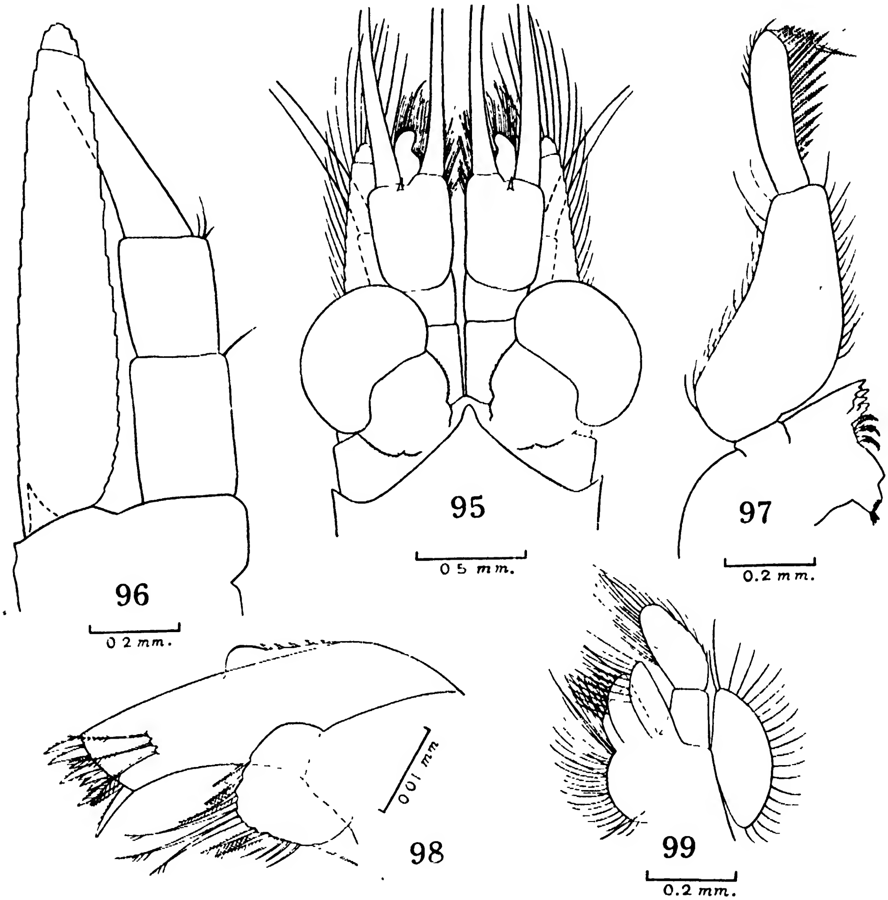
long as the antennular peduncle and about twice as long as the antennal peduncle. Basal joint, from which the scale arises, with a prominent spine on the outer distal corner.

First maxillae with ridge on the outer margin of the outer plate armed with about 5 spinules.

Third to the eighth thoracic limbs with propodite divided into 3 joints.

Basal plate of the exopod of the thoracic limbs with a small spine on the outer distal corner.

Fourth pleopod of the male reaching to the posterior end of the last abdominal somite: exopod 3-jointed, the first joint about 3 times as long as



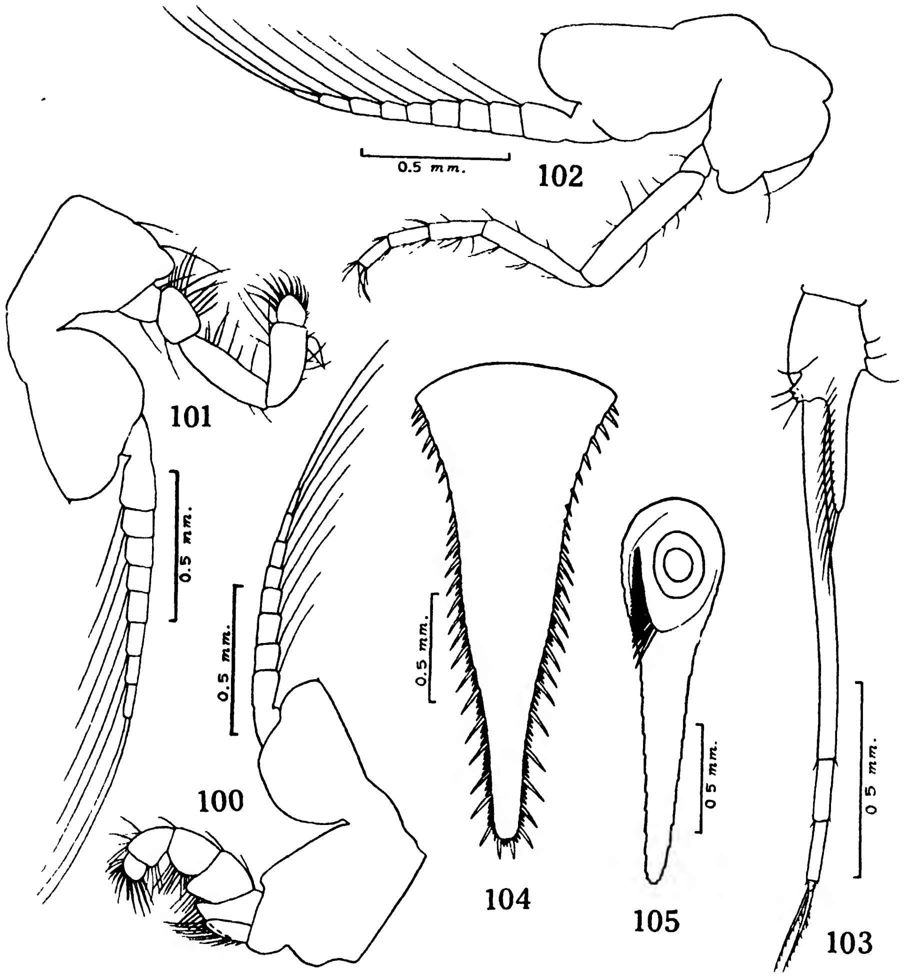
Figs. 95-99. *Proneomysis misakiensis* n. sp.

Fig. 95. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.
Fig. 96. Antennal scale and peduncle.
Fig. 97. Mandible and palp.
Fig. 98. First maxilla.
Fig. 99. Second maxilla.

the endopod, the second and the third joints almost equal in size and $^1/_6$–$^1/_7$ of the first joint, the third joint terminated by 2 strong spinous setae, about $1^2/_3$ times as long as the joint.

Telson long triangular, slightly shorter than the twice of the length of the last abdominal somite and $2^1/_2$ times as long as broad at the base; lateral margins concave in the first $^1/_3$ part, convex in the second $^1/_3$ part and then

gradually narrowing to a narrowly rounded apex; the lateral margins densely armed throughout their length with many spines, the proximal $^1/_3$ of the margins with about 10 short stout spines rather widely spaced, the remaining



Figs. 100–105. *Proneomysis misakiensis* n. sp.

Fig. 100. First thoracic limb.
Fig. 101. Second thoracic limb.
Fig. 102. One of the posterior thoracic limbs.
Fig. 103. Fourth pleopod of the male.
Fig. 104. Telson.
Fig. 105. Inner uropod.

part of the margins with the spines grouped into 12–15 sets, each set composed of a large spine followed by 1–5 small ones; the apex' armed with 2 pairs of spines, the longer outer pair about $^1/_{18}$ of the length of the telson and the inner pair equal in size to the shorter spines on the lateral margins.

Inner uropod about as long as the telson, with 30–35 spines on the ventral inner margin near the statocyst.

Outer uropod $^1/_4$ longer than the telson.

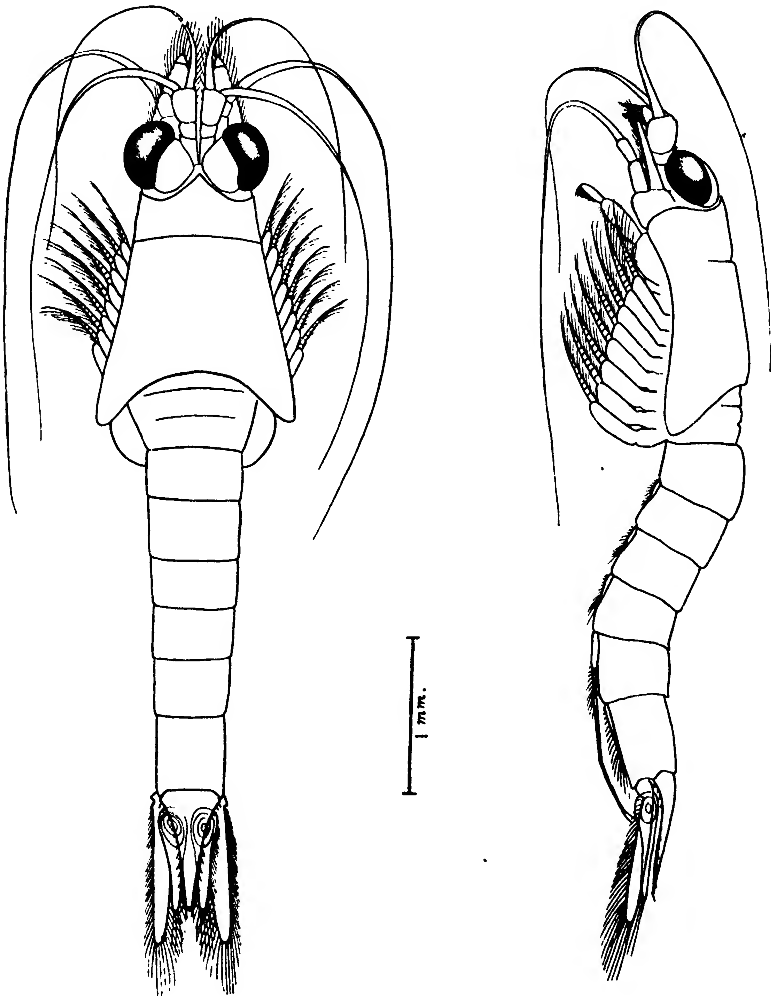
Length. Adult males and females, 9–10 mm.

REMARKS. The present species is closely allied to both *P. fusca* and *P. eriopedes* but the fold on the abdominal somites and the shape of the telson will serve to distinguish it from both of them.

Superficially this species is very closely allied to *Acanthomysis mitsukurii* (Nakazawa), but is distinguishable from it by the number of joints on the fourth pleopod of the male and by the absence of the spines on the abdominal somites.

Proneomysis perminuta n. sp.

Figures 106–116.



106 107

Figs. 106–107. *Proneomysis perminuta* n. sp.

Fig. 106. Dorsal view of adult female. Fig. 107. Lateral view of adult male.

LOCALITY. Aziro, Sizuoka Prefecture.

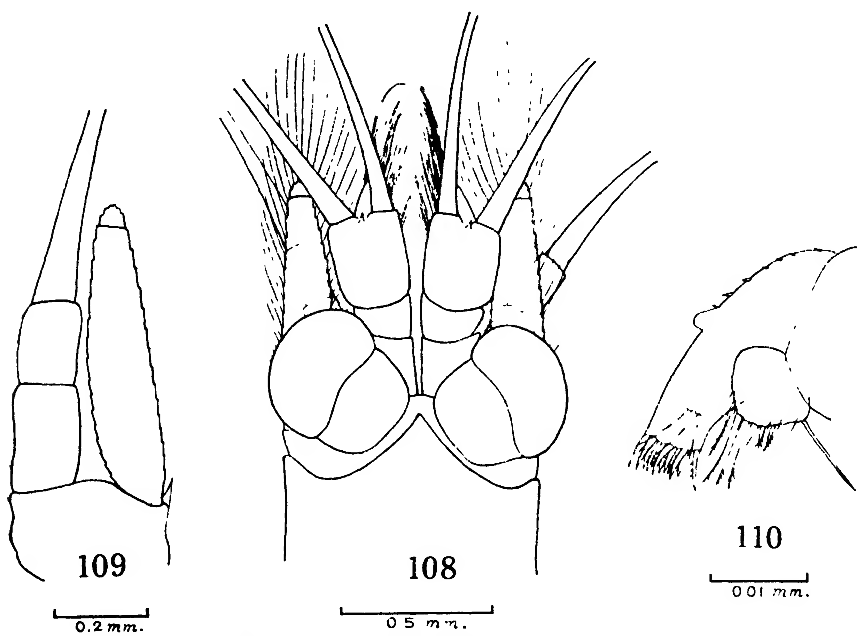
Type specimen. Abundant, adult males and females.

DESCRIPTION. Front margin of the carapace produced into a short triangular rostral plate with an obtusely pointed apex; antero-lateral corners of the carapace rounded.

Eyes slightly depressed in lateral view, in dorsal view the whole eye is about as long as broad and cornea is about half as long as the entire length of the eye.

Antennular peduncle short and stout, the third joint about as long as the 2 proximal joints combined, male sexual appendage short and triangular.

Antennal scale slightly longer than the antennular peduncle, in the male extending as far forward as the tip of the male sexual appendage, about 4 times as long as broad, apex rounded, 2-jointed, the distal joint about $^{1}/_{13}$ of the entire length of the scale. Basal joint, from which the scale arises, with a prominent spine on the outer distal corner.



Figs. 108–110. *Proneomysis perminuta* n. sp.

Fig. 108. Anterior end of a male to show rostral plate, eye, antennule and antennal scale.

Fig. 109. Antennal scale and peduncle.

Fig. 110. First maxilla.

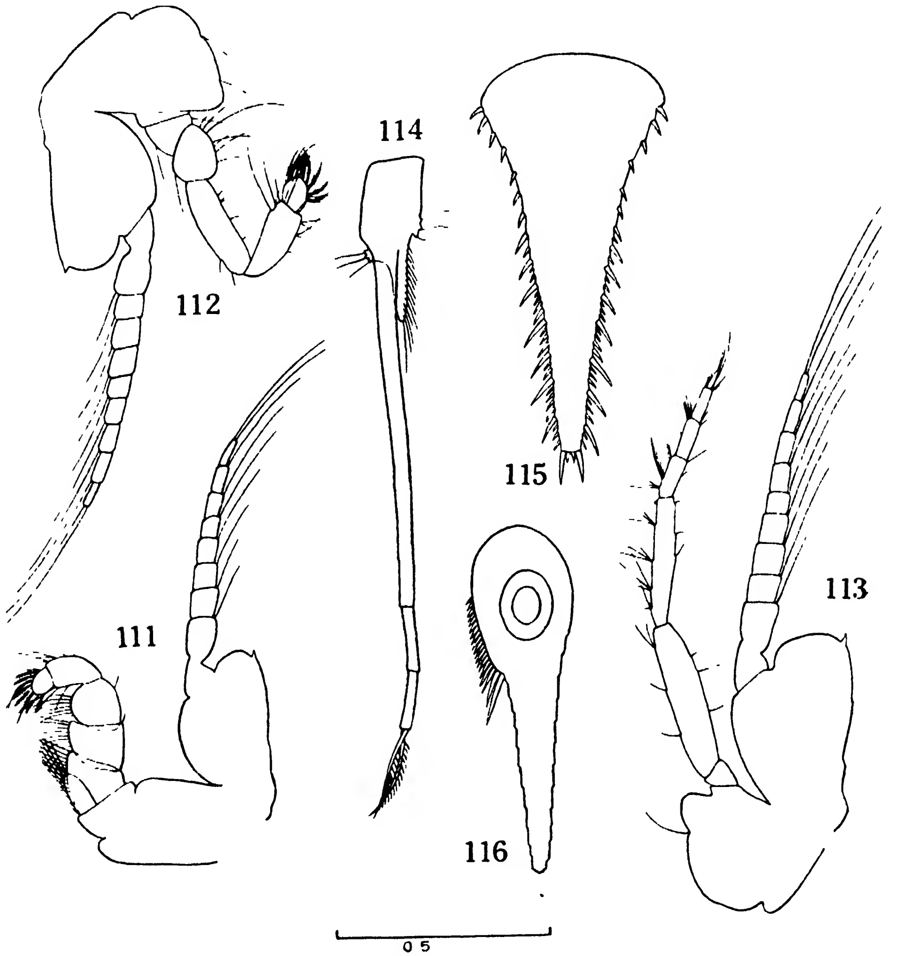
Antennal peduncle stout and slightly shorter than the antennular peduncle.

Mouth parts, first and second thoracic limbs showing no very marked difference from those in other species of the genus except for the outer margin of the outer plate of the first maxillae provided with several small spines.

Third to the eighth thoracic limbs with propodite divided into 3 joints. Basal plate of the exopod of all thoracic limbs provided with a spine on the outer distal corner.

Last thoracic somite with one or two faint transverse grooves on the dorsal side.

Fourth pleopod of the male very long, reaching to the posterior end of the statocyst; endopod small; exopod 3-jointed, the first joint very long, the second and the third joints equal in size and about $^1/_7$ of the first joint, terminal setae slightly longer than the third joint.



Figs. 111–116. *Proneomysis perminuta* n. sp.

Fig. 111. First thoracic limb.
Fig. 112. Second thoracic limb.
Fig. 113. One of the posterior thoracic limbs.
Fig. 114. Fourth pleopod of the male.
Fig. 115. Telson.
Fig. 116. Inner uropod.

Telson triangular, $1^2/_3$ times as long as the last abdominal somite and about twice as long as broad at the base; lateral margins tapering to a narrow but

distinctly truncate apex which is about 1/5 the width of the base; the lateral margins armed throughout their entire length with about 14 strong spines which increase in length toward the apex, on the distal half of the margins the spaces between the strong spines are occupied by 1–4 small spines; the apex armed with four spines, the outer spines about as long as the larger spines on the lateral margins and about thrice as long as the inner.

Inner uropod slightly longer than the telson, with a row of 16–20 strong spines on the ventral inner margin near the statocyst.

Outer uropod about $1\frac{1}{4}$ times as long as the telson.

Length. Adult males and females, 5 mm.

REMARKS. The present species is very closely allied to *P. fusca* but differs from it in the body length and in the shape of the rostrum and the telson.

This species also shows many points of resemblance to *P. misakiensis*, but is distinguishable by the body length and by the absence of the fold on the abdominal somites.

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19. Report on the Cirripedia Collected in the Malayan Waters by the Ship 'Zuihô-maru'

By Fujio Hiro

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(With 9 Text-figures)

INTRODUCTION

This small collection of cirripeds was brought to me by the "Zuihô-maru", the surveying ship of the South Sea Islands Bureau, from the Malayan waters (mainly the Banda Sea), where she had cruised for fisheries investigation from 13th Sept. to 8th Nov. of 1934. For giving me the opportunity to study this collection I offer my thanks to Mr. Y. Ban, the director of the expedition. My thanks are also due to the scientists on board the ship, Mr. Y. Hori and Mr. K. Nakasone who were at pains to collect the material.

In all, the following eleven species are represented:

Lithotrya valentiana (Gray, 1825)
Oxynaspis celata Darwin, 1854
Conchoderma virgatum (Spengler, 1790)
Balanus amphitrite Darwin, 1854
Balanus amaryllis Darwin, 1854
Balanus fujiyama Annandale, 1921
Balanus cuneiformis n. sp.
Acasta zuiho n. sp.
Tetraclita squamosa viridis Darwin, 1854
Tetraclita coerulescens (Spengler, 1790)
Tetraclita vitiata Darwin, 1854

As shown in Fig. 1, the localities of the collection belong mainly to the islands west of New Guinea, such as Kofiau, Solong, Ambon, Goram and Buton. Most of the species secured from these localities are littoral forms commonly found in this territory and have been studied thoroughly by previous investigators.

Two unrecorded species, *Balanus cuneiformis* and *Acasta zuiho* were taken from the shoal "Zyûmonzi-syô", as it is called by Japanese divers, S. Lat. 11°, E. Long. 130° between Tenimber Island and the northwestern end of Australia, one of the important spots of the pearl-oyster fisheries, and *Balanus fujiyama* which had been only imperfectly known from coral reefs in the northern part of the Indian Ocean, was rediscovered. These three interesting balanids were found while I was examining numerous individuals of the pearl oyster, *Pinctada maxima* which had been transported in living state to Palao

from that locality. The cirripedian fauna in the northern and western parts of Australia is little known except for the forms recorded in Broch's report (1916), among which are included four new species commensal with other animals from Pearling-Ground W. S. W. from Cap Jaubert, of the western part

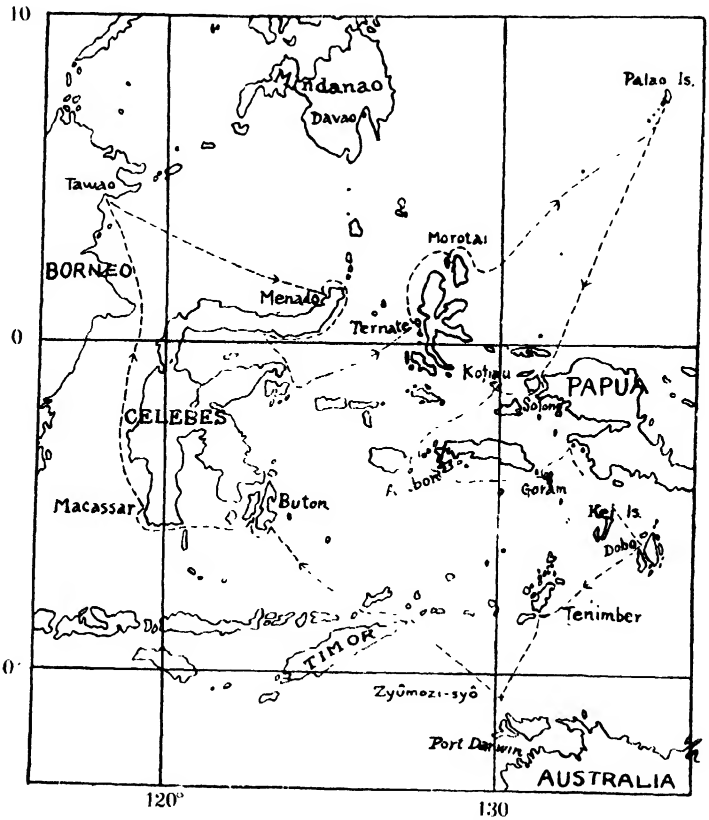

Fig. 1. Chart of the Malay Archipelago showing the course of a survey by the ship "Zuihô-maru".

of Australia. Cap Jaubert and "Zyûmonzi-syô" seem to be topographically and biogeographically similar. These findings thus indicate that if careful examination is made of various objects to which the cirripeds are attached, much should be added to our present knowledge of this group which is still insufficient even as regards the forms occurring in such well-investigated areas as the Malayan waters.

Systematic

LEPADOMORPHA

Family SCALPELLIDAE Pilsbry, 1907

Genus *Lithotrya* G. B. Sowerby, 1822

Lithotrya valentiana (Gray, 1825)

For the description and discussion see another paper dealing with the same group of the Palao Islands by myself to be published elsewhere.

LOCALITY: Solong, N. W. of New Guinea. 16–IX–1931. One small specimen boring in a fragment of limestone.

DISTRIBUTION: Philippine and Malay Archipelagoes, Friendly Islands, South Sea Islands.

Family OXYNASPIDIDAE Pilsbry, 1907

Genus *Oxynaspis* Darwin, 1851

Oxynaspis celata Darwin, 1851

The collection contains a full-grown dried specimen attached to an antipathalian. The scutum is of a normal shape with a rounded carinobasal angle, but separated from the carina by a narrow space. It measures 19 mm. in total length and 6.5 mm. in breadth of capitulum.

LOCALITY: Buton (or Bouton) Island. 10–X–1934.

DISTRIBUTION: Madeira, Japan, Philippine, Westaustralia and Bay of Bengal, as subsp. *indica* Annandale.

Family LEPADIDAE Darwin, 1851

Genus *Conchoderma* Olfers, 1814

Conchoderma virgatum (Spengler, 1790)

(Fig. 2)

I have little to add to the detailed descriptions of this well-known species given by previous authors. As shown in Fig. 2, all the specimens of this collection have features typical of the species with the purplish black bands on the integument arranged in the following manner:

(Capitulum) (Peduncle)

Scutal bands (2)

Lateral bands (2)

Carinolateral bands (2)

Carino-peduncular band (1)

Carinal bands (2)

The scutal and lateral bands on the capitulum and peduncle are large and

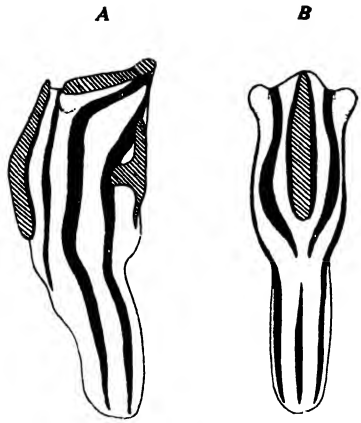

Fig. 2. *Conchoderma virgatum* (Spengler)
Diagram showing the arrangement of the black bands. A, Lateral view; B, carinal view.

generally become confluent above the scutum, though the lateral band may be cut off, as in Darwin's specimen (1851, pl. III, fig. 2). The other three bands near the carinal side are narrow and usually separate, but sometimes become confluent below the carina and even unite into a single band, as shown in Pilsbry's (1907, pl. IX, fig. 1) and Broch's (1924, fig. 20 a) specimens; sometimes they even disappear altogether.

The largest specimen in the collection measures 34 mm. in length of body and 10 mm. in breadth of capitulum.

LOCALITIES: S. Lat. 4° 10′, E. Long. 130° 45′, 15 miles off Goram Island. 22–IX–1934. Five specimens attached to a parasitic copepod *Penella* collected from *Tetrapturus mitsukurii* Jordan and Snyder.

N. Lat. 2° 40′, E. Long. 128° 32′, 4 miles off Morotai Island. 3–XI–1934. Three specimens attached to *Penella* from *Tetrapturus mitsukurii*.

DISTRIBUTION: Warm temperate and tropical seas, Pelagic.

BALANOMORPHA

Family BALANIDAE Gray, 1825

Genus *Balanus* da Costa, 1778

Balanus (*Balanus*) *amphitrite* subsp. undeterm.

Some small dried specimens which are attached to mussel and brachiopod shells are without opercular valves and badly preserved, so that it is difficult to assign them to any subspecies of this species.

LOCALITY: Macassar, southwest of Celebes. 15-X-1934. Four dried specimens on *Anadara tricenicosta* (Nyst) and two small ones on *Lingula* sp.

Balanus (*Chirona*) *amaryllis* Darwin,*) 1854

The species with its varieties has been described thoroughly by several previous authors. The typical form is named *eu-amaryllis* by Broch (1922) and includes the varieties: *roseus* of Lamarck (=var. *a* of Darwin), *niveus* of Gruvel (1902) (=var. *b* of Darwin), *dissimilis* and *clarovittata* of Lanchester (1902), and *laevis* of Broch (1931), which are classified mainly by the coloration of the shell. The collection contains some full-grown specimens taken from two different stations. Of these the specimens from Goram Island are uniformly rosy without any longitudinal bands and are referable to var. *roseus*,

*) According to Withers (1923), this species is identical with the fossil form *Balanus sublaevis* J. de C. Sowerby, 1840, but for the recent species this name is adopted at present.

while the only single specimen from Zyûmonzi-syô is longitudinally banded. But there is no difference in shape between the two, as is also the case with *Balanus tintinnabulum rosa* which was reported by Hiro (1932). The internal surface of the parietes is strongly ribbed longitudinally. The sutural edge of the radii is finely toothed.

Measurement in millimeters:

Carino-rostral diameter	21	21	20	19	18
Height	16	15	13	10	15

LOCALITIES: Goram Island. 22-IX-1934. Sixteen specimens on a large gastropod, *Murex* (*Chicoreus*) *ramosus* Linné.

S. Lat. 11°, E. Long. 130°, "Zyûmonzi-syô". N. off Port Darwin, N. W. Australia. 3-X-1934. A specimen on *Pinctada maxima* Jameson.

DISTRIBUTION: Southern Japan, China, Philippine and Malay Archipelagoes, Indian Ocean, Northern Australia.

Balanus (*Armatobalanus*) *fujiyama* Annandale, 1924

(Figs. 3, 4)

Balanuz terebratus Borradaile, 1903, p. 442
Balanus terebratus Annandale, 1906, p. 148
Balanus fujiyama Annandale, 1924, pp. 62–63

This species was described first by Annandale from the Gulf of Manaar, Indian Ocean, but no description of its internal parts is given. It has never been reported since, so that the present discovery is of some interest and deserves a detailed description.

The external appearance agrees well with the original description, and

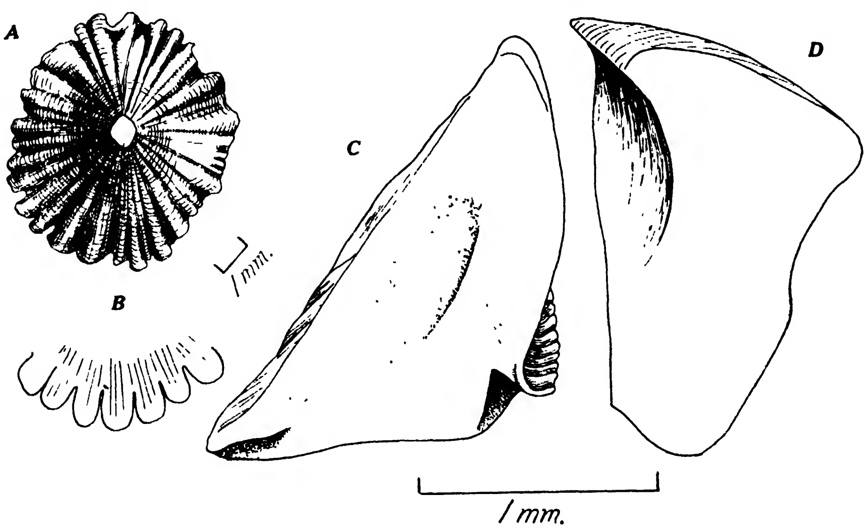

Fig. 3. *Balanus fujiyama* Annandale
A, Shell in apical view; B, marginal part of base; C, inner side of scutum; D, inner side of tergum.

resembles that of *Balanus terebratus* Darwin. In coloration the species reminds one of young specimens of *Balanus trigonus* Darwin. However, it is distinguishable from both by the minute orifice and the absence of perforation in the base. The opercular valves agree with the original description, but the tergum of the present specimen is somewhat broader.

Scutum with smooth growth-lines, a long and strongly developed articular ridge and an indistinct adductor ridge. The pit for the lateral depressor muscle is deep and that for the adductor muscle is well defined, but shallow and elongate.

Tergum nearly triangular, with a sharply pointed apex though not beaked; spur short, obliquely truncated, somewhat wider than half the basal margin of the valve, and the extremity is rounded, but a little separated from the basiscutal angle.

Mouth-parts have the appearance typical of the subgenus *Armatobalanus*.

Labrum with a tooth on each side of a deep median notch.

Palpus elongate.

Mandible with five distinct teeth and a lower angle with a tuft of spine-like teeth; second and third teeth bifid.

Maxilla I with eight strong spines, of which the middle four are somewhat

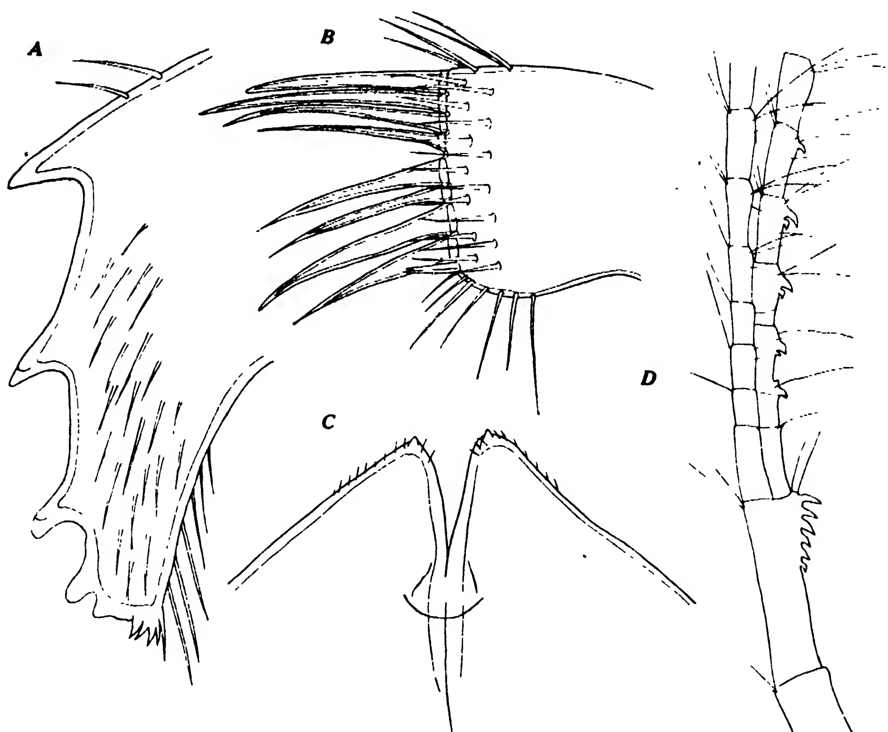

Fig. 4. *Balanus fujiyama* Annandale
A. Mandible; B. maxilla I; C, labrum; D, lower part of cirrus IV.

shorter; the straight frontal edge and the lower angle bearing a few minute bristles.

Maxilla II with broad upper and lower lobes which are clothed with numerous bristles on the inner surface.

Cirri have the following numbers of segments in their rami:

I		II		III		IV		V		VI	
16	8	8	9	9	10	13	15	18	19	30	30

In cirrus I the posterior ramus is somewhat more than 1/3 the length of the anterior and bears some pectinated spines at the extremity. Cirri II and III, of which the former is the shortest of all the cirri, have subequal rami. In cirrus IV the lower segments of the anterior ramus and the upper half of the protopodite bear a few recurved teeth on the frontal edge. Cirrus VI is much longer than the other cirri. Most segments in these posterior cirri are elongate and bear each two pairs of ventral spines.

Penis annulated and much longer than cirrus VI.

Measurements in millimeters:

Carino-rostral diameter	6.0	5.6	5.3	5.0
Height	3.0	3.0	3.0	3.0

LOCALITY: S. Lat. 11°, E. Long. 130°, "Zyûmonzi-syô", N. off Port Darwin, N. W. Australia. 3-X-1934. Some specimens on *Pinctada maxima* Jameson.

DISTRIBUTION: Laccadive and Maldive Archipelagoes (acc. to Borradaile); Gulf of Manaar, attached to the coral *Turbinaria crater* (acc. to Annandale).

Balanus (*Membranobalanus*) *cuneiformis* n. sp.

(Figs. 5, 6, 7)

Shell fragile, conical, with a small orifice and cup-shaped membranous base. The carina is moderately narrow, with a keel starting from the apex. The carinolateral compartment is the narrowest plate of the wall and about half as wide as the lateral compartment. In these three compartments, which are elongated triangular in shape, the sheath has a broad area and extends nearly to the base, and shows distinct, parallel growth-lines except on the narrow part on the side which overlaps the ala of the neighbouring compartment. The lower edge of the sheath is not free, being closely attached to the smooth surface of the paries. The ala is wide, but there is no radius. The rostrum is the widest and longest of all the compartments and cuneiform in shape, though not so bowed as in the other species of this subgenus; its sheath occupies about 2/3 the whole length of the rostrum and the paries below the sheath is triangular, slightly hollowed out and partitioned with two faint ribs.

Scutum triangular, with finely crenated growth-lines, so as to show longitudinal striation. There is a broad longitudinal depression in the middle, instead of two as found in the allied *Balanus longirostrum* HOEK. The articular

ridge is rather strong, about 2/3 as long as the tergal margin and its lower end is oblique. There is a trace of adductor ridge and a broad and deep pit for the lateral depressor muscle.

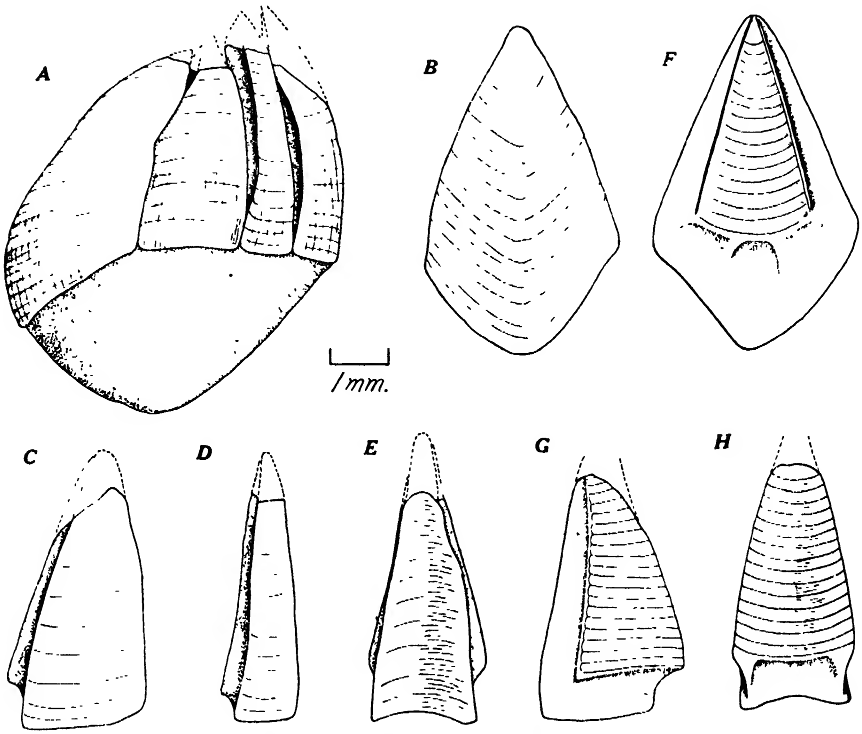

Fig. 5. *Balanus cuneiformis* n. sp.
A, Shell in latera lview; B, outer side of rostrum; C, outer side of lateral compartment; D, outer side of carinolateral compartment; E, outer side of carina; F, inner side of rostrum; G, inner side of lateral compartment; H, inner side of carina.

Tergum subtriangular, much wider than the scutum. Externally it is flat, with simple growth-lines and it bears no furrow on the spur. The spur is very short, obliquely truncated and 2/3 as wide as the basal margin. The internal surface near the apex is roughened with lengthened tubercles as in that of *Balanus orcutti* PILSBRY.

MOUTH-PARTS: Labrum hairy, with three teeth on each side of a deep notch. Palpus elongate, provided with bristles along the inner margin and on the distal part.

Mandible with five teeth, of which the second to the fourth are bifid, and with a pointed lower angle.

Maxilla I with straight frontal edge without any notch.

Maxilla II with an elongated, conical upper lobe and a small, oval lower lobe; both are furnished with bristles along the inner side.

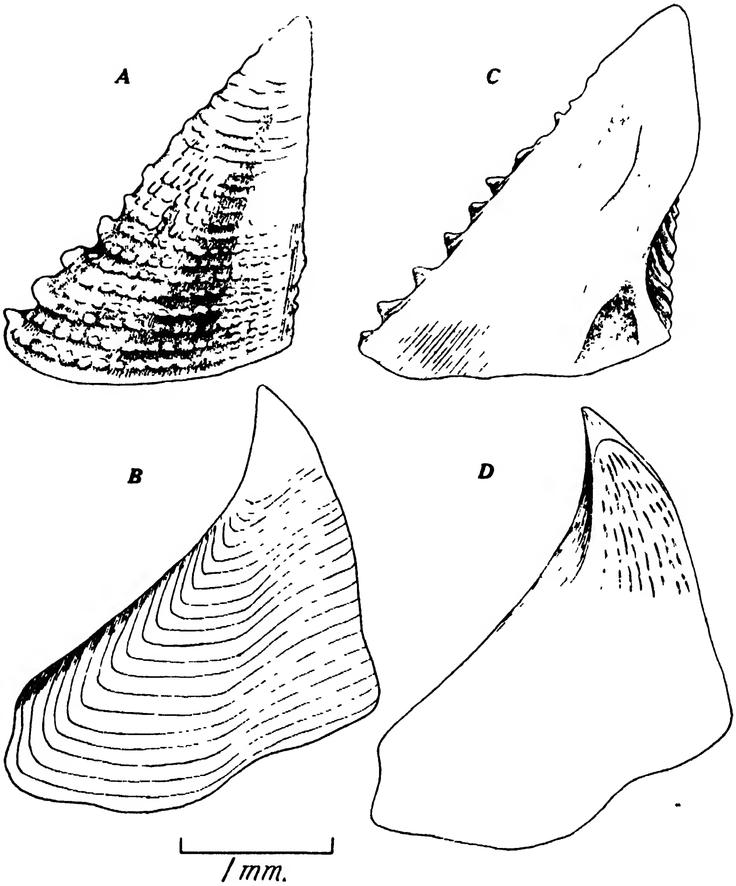

Fig. 6. *Balanus cuneiformis* n. sp.
A, Outer side of scutum; B, outer side of tergum; C, inner side of scutum; D, inner side of tergum.

Cirri have the appearance typical of *Membranobalanus*. Their numbers of segments are as follows:

I		II		III		IV		V		VI	
25	7	11	10	13	12	19+	24+	27	27	33	33

Cirrus I has the anterior ramus about four times as long as the posterior. In cirri II and III, the anterior ramus is slightly longer than the posterior. In cirrus IV, the lower segments of the anterior ramus and the two segments of the protopodite are elongated, not protuberant and have a comb-like row of short, erect teeth on the distal anterior angle in each segment; this feature of cirrus IV is shared by *Balanus longirostrum* HOEK also and seems to be an important characteristic of the subgenus *Membranobalanus*.

Penis longer than cirrus VI.

Measurements in millimeters:

	(Type)			
Carino-rostral diameter	6.2	6.3	4.7	3.7
Height of basal part	2.0	2.5	2 2	1.5
Length of rostrum	6.2	6.5	4.3	3.8
Length of laterals	4.5	4.5	3.2	3.0

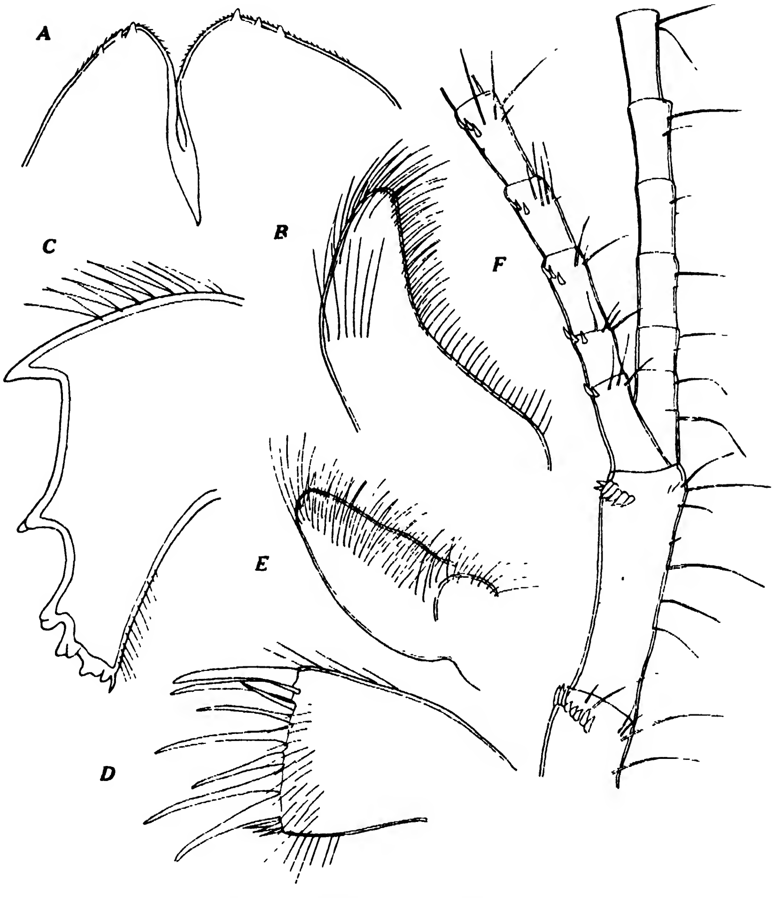

Fig. 7. *Balanus cuneiformis* n. sp.
A, Labrum; B, palpus; C, mandible; D, maxilla I; E, maxilla II; F, lower part of cirrus IV.

LOCALITY: S. Lat. 11°, E. Long. 130°, "Zyûmonzi-syô", N. off Port Darwin, N. W. Australia. 3–X–1934. Five specimens, lodged each in a hole bored by a sponge, *Cliona* on shells of *Pinctada maxima* Jameson.

REMARKS: *Membranobalanus*, a subgenus of the genus *Balanus*, is very peculiar in structure and easily distinguishable from the other subgenera, as was pointed out by Hoek (1913). Of this subgenus the following three species have been known up to this time:

Balanus declivis Darwin, 1854, West Indies, Bermuda, (?) Black Sea.
Balanus orcutti Pilsbry, 1907, California, South Africa.
Balanus longirostrum Hoek, 1913, Malay Archipelago.

The differences between the present new species *Balanus cuneiformis* and the three already recorded species cited above are summarized below:

	B. declivis	*B. orcutti*	*B. longirostrum*	*B. cuneiformis*
Shell	small	larger	small	small
Rostrum	less than 10 mm. long, boat-shaped, lower half broadly rounded	about 18 mm. long, tongue-shaped, lower half broadly rounded	less than 10 mm. long, fig-fruit-shaped, lower half narrower, tapering	less than 10 mm. long, wedge-shaped, lower half triangular
Sheath of rostrum	about 1/4 the whole length	about 1/3 the whole length	about 1/2 the whole length	about 2/3 the whole length
Inner face of parietes	smooth, sometimes with weak ribs	with distinct ribs	with distinct ribs	smooth
Radii	present, rather wide	extremely narrow or absent	present, narrow	absent
Scutum	sometimes with a slight longitudinal depression, growth-lines crenated, adductor ridge weak or none	longitudinal depression absent, growth-lines smooth, adductor ridge well-developed	with 2 longitudinal depressions, growth-lines crenated, adductor ridge absent	with a longitudinal depression, growth-lines crenated, adductor ridge weak
Tergum	with spur occupying 1/2 the basal margin	with spur occupying 2/3 the basal margin	with spur occupying 1/2 the basal margin	with spur occupying 2/3 the basal margin
Cirrus IV	with erect distal and recurved frontal teeth	?	with erect distal teeth	with erect distal teeth

As shown in the above table, the characteristics of *Membranobalanus* consist in the solid walls, cup-shaped membranous base, lengthened rostrum and armature of erect teeth on cirrus IV. These morphological characteristics, as well as the peculiar habitat in the tissue of sponge, lead one to the view that the subgenus is closely related to *Acasta*. In fact, Pilsbry (1916, p. 241) writes that: "It would not be amiss to speak of *Membranobalanus* as an *Acasta* with membranous basis, just as *Semibalanus* is a *Balanus* with membranous basis".

This view appears adequate at first sight, but in reality is not quite so. Barnard (1924) has recorded *Acasta membranacea* which has a membranous base. Judging from his description, however, this species seems to have none of the other peculiarities of *Membranobalanus*. Therefore the question as to whether the base is calcareous or membranous is apparently of no generic or subgeneric importance, but is merely a secondary matter, just as it is in *Pachylasma* where various degrees of calcification of the base are met with.

As cited above, **Balanus declivis** has rather wide radii; in **Balanus cuneiformis**, on the contrary, radii are absent, and in the remaining two species they are extremely narrow or entirely wanting. Still these four species should be ranked in a single group because of other important characters. In this connection we are reminded of Nilsson-Cantell's *Pseudoacasta* (1930), of which the type species *P. libera* has no radii. In his opinion, the absence of radii should be a primitive feature. Later (March, 1931) the same author described a second species *P.* (?) *flexuosa* (=*Acasta amakusana* Hiro, Nov., 1931) which has narrow radii. It is noteworthy that *Pseudoacasta* is closely related to *Acasta*, but at the same time somewhat related to *Membranobalanus*, especially in the features of compartments (the question as to whether *Pseudoacasta* is of any generic value or not is put aside for the present). However, the opercular valves of *Membranobalanus* resemble those of *Conopea*, a subgenus of *Balanus*, more closely than those of any other subgenera in *Balanus* or *Acasta*. At any rate it can not be denied that the subgenera of *Balanus* and *Acasta*, and even *Pseudoacasta* are closely related to one another. Therefore, it is hardly permissible to raise these subgenera to the generic rank, at least from the morphological point of view. If the absence of the radii and membranous base are primitive features, *Membranobalanus* should be the most primitive balanid, just as *Pseudoacasta* is a primitive form of *Acasta*. But it is not altogether impossible that these features are due to degeneration or even specialization in structure. In my opinion, *Membranobalanus* and *Pseudoacasta* are specialized forms of ordinary *Balanus* and *Acasta* respectively. In any case it is obvious that *Membranobalanus* stands in general structure between *Balanus* and *Acasta*.

Genus *Acasta* Leach, 1817

Acasta zuiho n. sp.

(Figs. 8, 9)

This new species is closely related to *Acasta cyathus* DARWIN, 1851, but differs mainly in the extreme narrowness of the carinolateral parietes, weak calcareous projections and the peculiar structure of cirrus IV.

Shell white, sometimes tinged with light purple and furnished with minute calcareous projections on the compartments. The carina is strongly bowed towards the apex and about as wide as the lateral compartment. Of the carinolateral compartment the parietal area is extremely narrow, distinguishable only with the aid of a lens, and tapering upwards but not reaching the apex of the valve. The rostrum is the largest of all the compartments and nearly as high as the carina. Internally these compartments are ribbed below the sheath which occupies the upper half of the wall, and smooth without visible striation; the internal side of the radii has obvious ribs parallel to the base. The radii and alae are very broad and marked distinctly by horizontal growth-lines. The orifice is rather small and notched.

Base saucer-shaped or nearly flat, with the margin finely indented; inter-

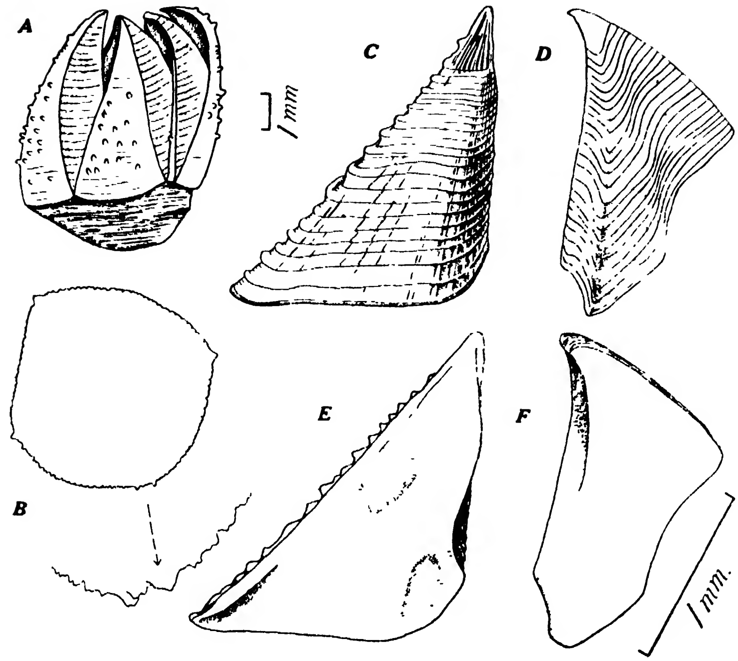

Fig. 8. *Acasta zuiho* n. sp.
A, Shell in lateral view; B, basal cup showing the indented edge; C, outer side of scutum; D, outer side of tergum; E, inner side of scutum; F, inner side of tergum.

nally smooth.

Scutum triangular, with straight margins. The external surface is furnished with longitudinal ribs, especially remarkable on the tergal side. The pits for lateral depressor and adductor muscle are rather deep and oblong in shape. The articular ridge is low and about two-thirds the length of the tergal margin; the adductor ridge is absent.

Tergum with a spur half as wide as the basal margin and obliquely truncated; externally furrowed slightly along the spur; internally smooth.

MOUTH-PARTS: Labrum with three teeth on each side of the median notch. Palpus elongated; the distal margin is straight, and the inner and outer margins are nearly parallel to each other, though both are slightly concave in the middle.

Mandible with five teeth, of which the second to fourth are bifid, and a lower angle armed with two spine-like teeth.

Maxilla I with nine spines, of which the upper two and lower two are very strong, and two to four spinules on the lower angle, arranged along the straight frontal edge.

Maxilla II with the upper lobe elongated and pointed, with the frontal edge concave. The lower lobe is small and convex. Both lobes are furnished with bristles.

Cirri have the following numbers of segments in their rami:

		I		II		III		IV		V		VI	
4.5 mm. in diam.	left —	18	7	10	7	11	9	8	10	16	18	18	21
	right —	19	7	11	7	12	10	10	13	18	19	21	21

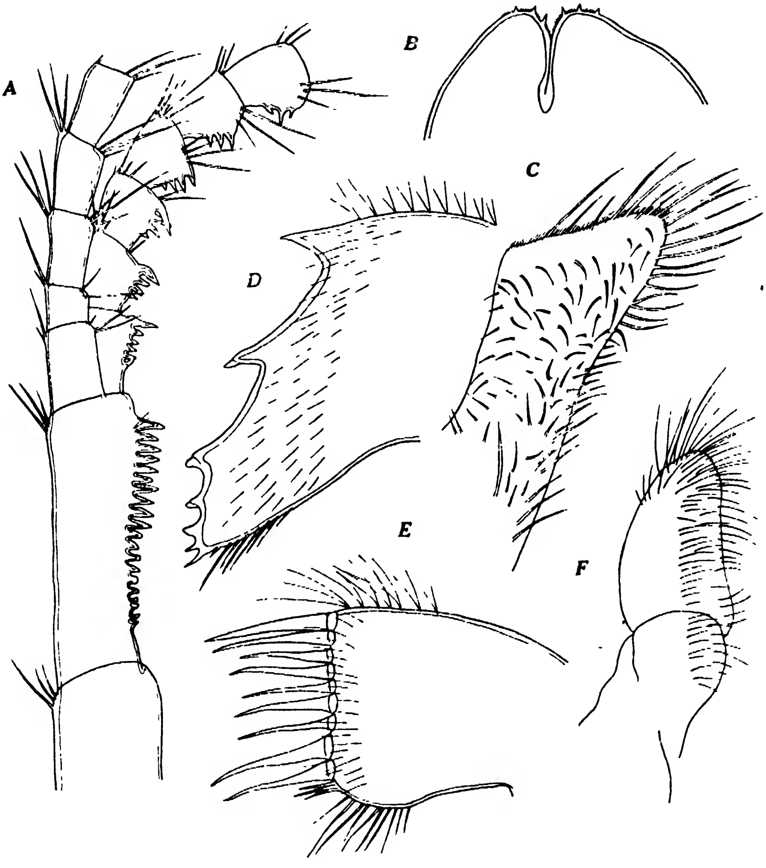

Fig. 9. *Acasta zuiho* n. sp.
A, Lower part of cirrus IV; B, labrum; C, palpus; D, mandible; E, maxilla I; F, maxilla II.

In cirrus I–III the anterior ramus is longer than the posterior. In cirrus I the ratio of the length of rami is about 5 : 2. Cirrus IV bears generally four recurved teeth at the protuberant frontal edge of each segment of the

Numbers of recurved teeth of each segment of cirrus IV											
	Protopodite		I	II	III	IV	V	VI	VII	VIII	IX
Left	10 (large)	10 (small)	6	4	4	4	3	3	0	0	0
Right	10	11	4	3	4	4	4	4	4	2	1

anterior ramus and also a row of erect teeth along the frontal side of the distal segment of the protopodite.

In cirrus V also, the anterior ramus bears an unrecurved tooth on each segment from the fifth to the twelfth.

Penis very long, about four times as long as cirrus VI.

Measurements in millimeters:

Carino-rostral diameter	4.5	4.5	4.3	3.9	3.8	3.2	2.9
Height (carinal side)	5.4	5.3	4.8	4.4	4.4	3.8	3.7

LOCALITY: S. Lat. 11°, E. Long. 130°, "Zyûmonzi-syô", N. off Port Darwin, N. W. Australia. 3-X-1934. 14 specimens embedded in a soft silicious sponge attached to a shell of *Pinctada maxima* Jameson.

Genus *Tetraclita* Schumacher, 1817

Tetraclita squamosa viridis Darwin, 1851

LOCALITIES: Ambon. 20-IX-1934; Kofiau Island. 17-IX-1934; Goram Island. 22-IX-1934.

DISTRIBUTION: Malay and Philippine Arch., China, Australia, South Sea Islands.

Tetraclita coerulescens (Spengler, 1790)

LOCALITY: Goram Island. 22-IX-1934.

DISTRIBUTION: Philippine and Malay Arch., South Sea Islands.

Tetraclita vitiata Darwin, 1854

LOCALITY: Goram Island. 22-IX-1934.

DISTRIBUTION: Phil. and Malay Arch., Great Barrier Reef, South Sea Is.

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20. Notes on the Development of Some Japanese Echinoids with Special Reference to the Structure of the Larval Body

By Katsuzo ONODA

Higher Normal School for Women, Nara

(With 9 Text-figures and Plates X–XIV)

After the publication, in 1931, of the paper on the development of *Heliocidaris crassispina*, the embryology of several other species of Japanese sea-urchins has been worked out on various occasions. The material includes the following species: *Mespilia globulus* A. Ag., *Echinometra Mathaei* (Blv.), *Toxopneustes pileolus* (Lamk.), *Echinostrephus moralis* A. Ag., *Temnopleurus toreumaticus* (Klein), *Tripneustes gratilla* (Linn.), *Diadema setosum* Gray, *Strongylocentrotus pulcherrimus* (A. Ag.), *Pseudocentrotus depressus* (A. Ag.). The results are published in the present paper.

Before proceeding to the main body of the description, I wish to express my grateful acknowledgement to Prof. Taku Komai of the Kyoto Imperial University, for his suggestions, guidance and encouragement throughout my work. My special thanks are also due to Dr. Theodor Mortensen and Dr. Isabella Gordon, for their kindness in sending me their important papers, and in giving me valuable advice. I owe much also to Dr. Austin Hobart Clark and Dr. Hubert Lyman Clark for their encouragement and the interest which they have taken in this study. The work has been accomplished through the financial aid of the Department of Education to which I acknowledge here my indebtedness.

Culture method

The vessels used for culture were of the capacity of 200 cc. The sea-water to be used for culture was secured from the open sea and was filtered. The water in the vessel was not changed throughout the course. The vessels covered with glass plates were wrapped with gauze, and placed in a box into which cool fresh water was conducted several times a day. Thus the temperature of the water in the vessel was kept at ca. 25°–27°C. The diatoms for food were collected by filtering the water in which seaweeds had been washed; a small quantity of the food was given once a day.

Mespilia globulus A. Ag.

This species is fairly common in the shallow waters of the coast of Japan and is often used together with *Heliocidaris crassispina* in laboratory exercises of embryology.

It is found in abundance in rocky zones which are covered with various debris. It breeds from the early part of July to August.

The transparency of the egg makes observation especially of the early developmental stage very easy. Young sea-urchins are formed in about a month.

Mortensen records the change up to the formation of the pedicellariae, but no description of the development from pluteus to metamorphosis has been published.

The egg measures ca. 0.08 mm in diameter. The blastula is formed in five hours after insemination. It is at first spherical in form with a rather large blastocoel surrounded by exceedingly transparent polygonal cells. With development the blastula becomes cylindrical (Text-fig. 1). It measures 0.27 mm in length and 0.3 mm in width in the thickest posterior region.

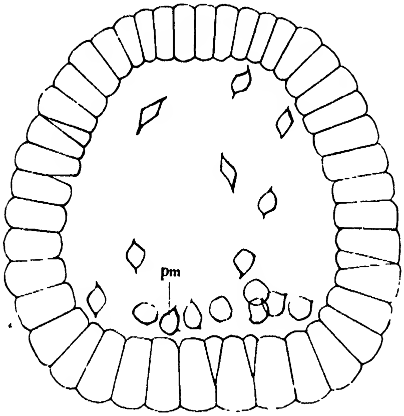

Fig. 1. *Mespilia globulus*. Blastula, about 10-hours old. pm, primary mesenchyme cells. Camera lucida drawing. ca. × 180.

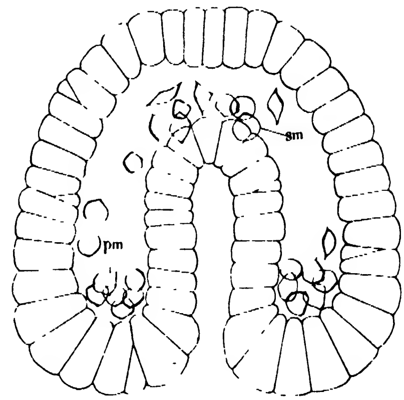

Fig. 2. *Mespilia globulus*. Gastrula, about 20-hours old. pm, primary mesenchyme cells; sm, secondary mesenchyme cells; Camera lucida drawing. ca. × 180.

Gastrulation begins about 16 hours after insemination and ends within ca. 20 hours (Text-fig. 2).

The pluteus of the first stage, six-days old, is represented in Pl. X, figs. 1 and 2. There is a simple recurrent rod (rr); the body skeleton does not form a basket structure; the postoral rod (lo). is fenestrated. The ventral transverse rods (vt) cross each other on the mid-line of the body; the body rod (br) is short. The body is truncated at the posterior end.

The second stage of pluteus (Pl. X, fig. 3) is characterized by the appearance of the postero-dorsal arm (pd), and begins seven or eight days after insemination. The postero-dorsal rod (ld) is fenestrated. The ends of the body rods have been absorbed and the rudiment of the dorsal arch (da) formed. The third stage (Pl. X, fig. 4) is characterized by the appearance of the preoral arms (pr) and is reached at about the fifteenth day. A little later the rudiment

of the posterior transverse rod (rp) appears. The posterior part of the larva is widened considerably. The four broad main arms are narrowed gradually towards the end, and are furnished each with a ciliated epaulet (ep) at the base.

The pluteus attains its full size in about 18 days after insemination. It measures ca. 1.5 mm from the posterior end of the body to the tip of the antero-lateral arms (ala).

In about 20 days after insemination the pluteus begins to metamorphose, and two pedicellariae (pe) are formed in the postero-median groove of the larva (Pl. X, fig. 5). The posterior transverse rod (ptr) acquires a very characteristic shape. The rod furcates into two branches, of which the lower is subdivided twice dorsi-ventrally. Each terminal branch thus formed has a series of thorns along its lower edge. The posterior lateral processes (plp) now present a characteristically angular form because of the stretching of these terminal branches of the posterior transverse rod within. At the posterior margin of the larva, there is no indication of the ciliated ring band which occurs in *Heliocidaris* larvae. In the dorsal arch (flp) only the first lateral processes are formed.

Yellowish-green patches (yp) are found near the end of the four main arms. In the 30-days old larva three larval spines have appeared; the first spine (sA) is situated between the two posterior pedicellariae; the second (sB) is found at the base of the dorsal arch, and the third (sC) on the right side of the larva. These spines may be called spine A, B and C respectively.

On the 35th day after insemination I found the larva in the beginning of metamorphosis (Pl. X, fig. 6). Five terminal tube-feet (tt) have emerged on the surface and the absorption of the arms is in progress. The echinus rudiment marked by greenish yellow pigment has grown large and a deep-green coiled intestine (it) is seen in the centre. As the absorption of the arms progresses the larval body becomes round, and some typical spines (ts) belonging to the corona appear. (Pl. X, fig. 7). In several hours there is a sea-urchin clinging to the bottom of the vessel by tube-feet. The dorsal and the ventral view of the young sea-urchin just after metamorphosis may be seen in Pl. XI, fig. 1 and 2 respectively. The dorsal area of the imago is made up of the right and posterior portions of the pluteus as shown in Pl. XI, fig. 1.

Of the ten primary ordinary tube-feet (ot), five are situated slightly adorally relative to the terminal tube-feet (Pl. XI, fig. 2). The first trace of mouth (rm) is represented by a pentagonal outline with angles in the inter-ambulacral zones.

About three days after the metamorphosis the urchin assumes a pentagonal form (Pl. XI, fig. 3). Each ambulacral zone carries one tetraradiate spine (tr) and one sphaeridium (sp), while each inter-ambulacral zone carries four typical spines (ts). Each typical spine has a thick collar around its base. Pl. XI, fig. 4 shows the ventral view of the same specimen as that in Pl. XI, fig. 3.

The first calcareous element (cd) formed in the echinus rudiment is the calcareous disc of each terminal tube-foot (Text-fig. 3). Next the rudiments

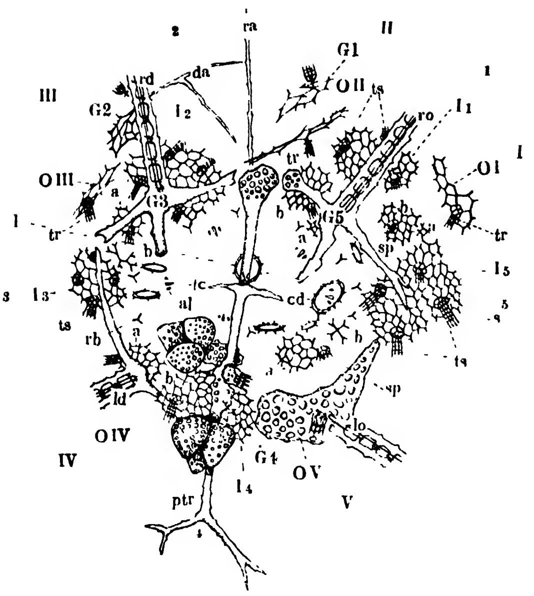

Fig. 3. *Mespilia globulus.* Elements of the test of a larva just prior to metamorphosis.
a, b, rudiments of ambulacral plates; al, alveolus (rudiment); cd, calcareous disc of terminal tube-foot; da, dorsal arch; G_1–G_5, genital plates (rudiments); I_1–I_5, inter-ambulacral plates (rudiments); ld, left postero-dorsal rod; lo, left postoral rod; l-s, Loven's plane of symmetry; O_I–O_V ocular plates (rudiments); ptr, posterior transverse rod; ra, right antero-lateral rod; rb, buccal plates (rudiments); rd, right postero-dorsal rod; ro, right postoral rod; sp, sphaeridium (rudiment); tc, tooth cone (rudiment); tr, tetraradiate spine (rudiment); ts, typical spine (rudiment); I–V, ambulacral zones; 1–5, inter-ambulacral zones. Camera lucida drawing. ca. ×200.

of ocular plates I, II and III make their appearance (O_I, O_{II}, O_{III}).

Nearly at the same time four more calcareous elements (the inter-ambulacral plates) are formed in each inter-ambulacral zone (I_1, I_2, I_3, I_4, I_5). The arrangement of these elements recalls that found in *Echinus miliaris* (Gordon, 1926).

Meantime tetraradiate and typical spines (tr, ts) appear on the oculars I, II, III and on the inter-ambulacral plates respectively. Next two calcareous plates (the ambulacral plates) are formed on each ambulacral zone. Of these Ib, IIb, IIIa, IVb, Va series appear much in advance of those in the other series Ia, IIa, IIIb, IVa, Vb. This difference in size of the plates is the first step of Loven's Law of heterotropy.

A little later the rudiment of sphaeridium (sp) appears in each of the Ib, IIb, IIIa, IVb and Va series of ambulacral zones. In the next stage a small granule is laid down on each inter-ambulacral as a primordium of the tooth cone (tc); also two small calcareous granules, one on each side of the tooth cone, make their appearance as the primordia of the alveoli (al). Almost at the same time ten triradiate spicules are formed, two on each inter-ambulacral zone and adoral to the inter-ambulacral plate as the primordia of ten buccal plates (rb). When the rudiments of the buccal plates have become reticular, the rudiments of the rotulae (rl) and epiphyses (eh) are laid down almost simultaneously on each ambulacral zone (Text-fig. 5).

The genital and ocular plates (G_1–G_5, O_I–O_V) originate similarly to those of *Heliocidaris crassispina* (Text-fig. 4).

Text-fig. 5 shows the ventral aspect of the same specimen shown in Pl. XI, fig. 4 which measures ca. 0.4 mm in diameter exclusive of the spines. The dorsal aspect of a more advanced urchin is shown in Text-fig. 6. Text-fig. 7 is a

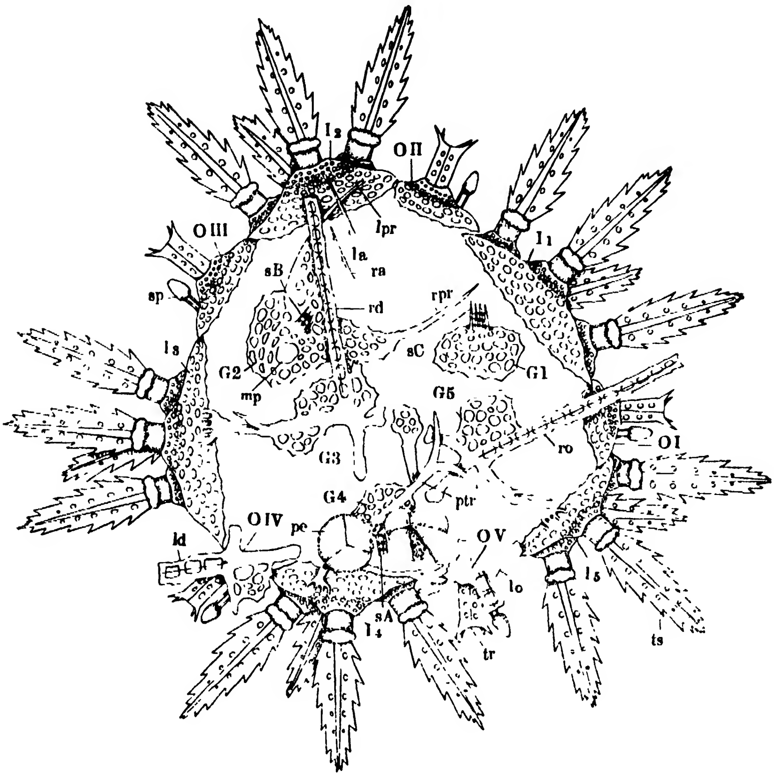

Fig. 1. *Mespilia globulus*. Dorsal aspect of a young sea-urchin. la, left antero-lateral rod; lpr, left preoral rod; mp, madreporic pore; pe, Pedicellaria; ptr, posterior transverse rod; rpr, right preoral rod; SA. B. C, spine A. B. C; Other legends as in preceding figs. Camera lucida drawing. ca. × 150.

view of the apical system of the imago at the age of two months. Every plate assumes a definite form and they are tightly connected with each other with a suture between. All ocular plates are exserted.

Echinometra Mathaei (Blv.).

This species is found rather commonly near the Seto Marine Biological Laboratory. It occurs in shallow water on rocky beaches and lives usually in a hole fitted for its body form. Usually one must pull the animal out of the hole to obtain it. The species belongs to tropical or subtropical sea-urchins and it is very scarce in most parts of Japan proper.

The development of the present species was studied by Th. Mortensen in Hawaii (1915) and by D. H. Tennent on the island of Merin in Murray Island (1925). In both cases the development of the larva was traced up to the first stage and special attention was paid to the morphology of the larva.

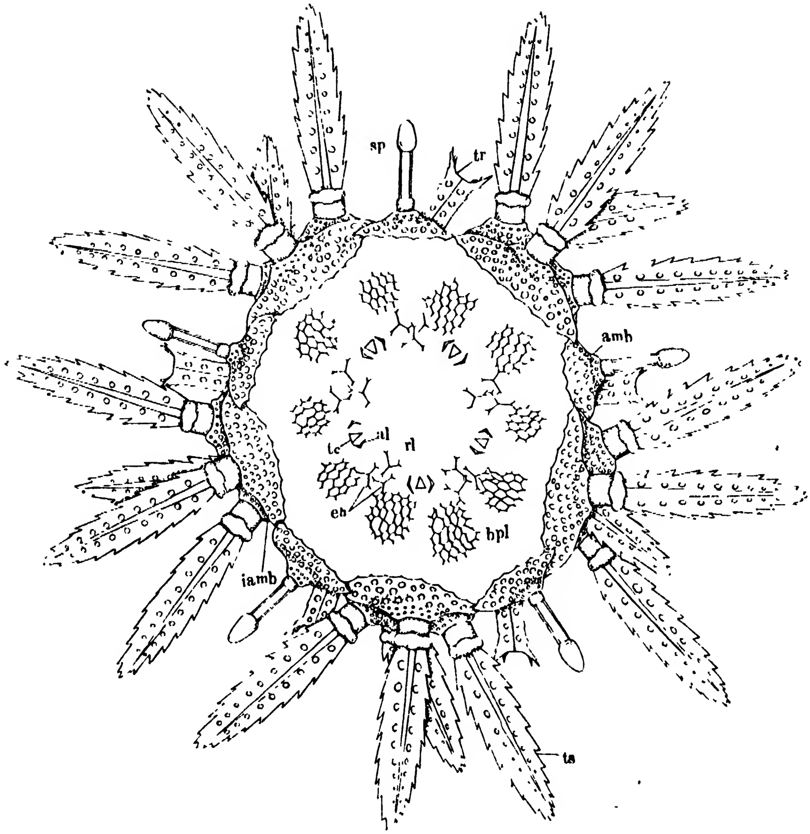

Fig. 5. *Mespilia globulus.* Ventral aspect of the same specimen as that in Fig. 1. amb, ambulacral plate; bpl, buccal plate; iamb, inter-ambulacral plate; eh, rudiment of epiphysis; rl, rudiment of rotula; Other legends as in preceding figs. Camera lucida drawing. ca. × 150.

Mortensen states, " de Meijere and H. Lym. Clark are inclined to regard *Ech. oblongata* only as an extreme form of *Ech. Mathaei*, while Döderlein makes it the type of a separate genus... On account of the incompleteness of this record of their development the question can not, of course, be regarded as settled " (1921). According to Tennent " The differences in the larvae may be a matter of some importance" (1929).

The ripe specimens are found usually in summer months July to August. All characteristic features of the early pluteus described by Tennent were observed. The early pluteus stage was reached in 27 hours after insemination (Plate XI, fig. 5).

The pluteus in the first stage reaches its maximum size ca. 0.6 mm, including the postoral arms, on about the eighth day (Pl. XI, fig. 6, pa); the postoral rod (lo) is fenestrated (Pl. XI, fig. 6). There are two recurrent rods (Pl. XI, fig. 5, p'r, sr), and the body skeleton has a compound basket structure. The ventral

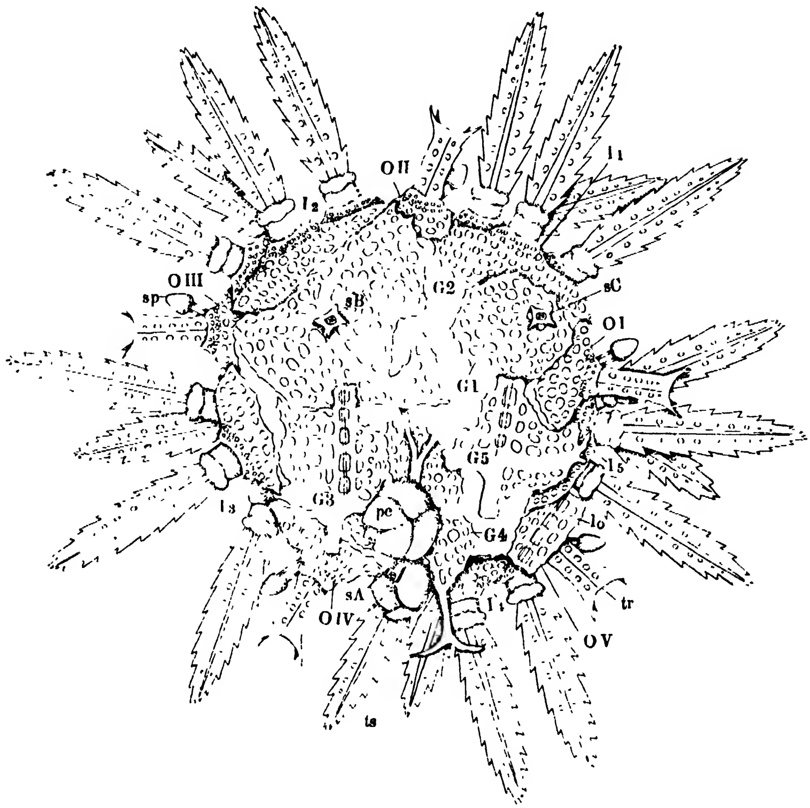

Fig. 6. *Mespilia globulus*. Dorsal aspect of an imago, after 20 days from metamorphosis. Legends as in preceding figs. Camera lucida drawing. ca. × 150.

transverse rods (vt) are connected with each other; the body rod (br) is short. The larva is very transparent with few pigment cells in the body proper, but an aggregation of such exists near the end of the arm. The body is scarcely truncated posteriorly and the stomach is yellowish in colour.

The rudiments of the dorsal arch (fig. 7, da) and the fenestrated posterodorsal rods (ld) were formed on the eighth day. On the 12th day I found the larva in the beginning of the second stage, being furnished with the posterodorsal arms (Pl. XI, fig. 7, pd), and the absorption of the body rods was in progress.

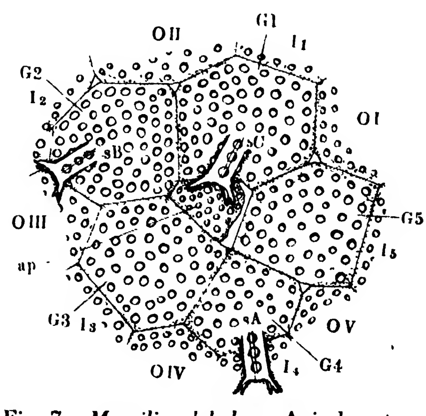

Fig. 7. *Mespilia globulus*. Apical system of an imago, after 2 months from metamorphosis. ap, anal plate; Other legends as in preceding figs. Camera lucida drawing; Diameter of the test, ca. 2 mm.

The third stage of the pluteus, 24-days old, characterized by the appearance of the preoral arms (pr), is represented in Pl. XII, fig. 1. In this stage the red pigment cells are very numerous and green pigment cells also are deposited along the postoral and postero-dorsal rods. The dorsal arch forms the first and second lateral processes (flp, slp). The ventral and dorsal vibratile lobes (vvl, dvl) exist; the dorsal vibratile band (dvb) is conspicuous.

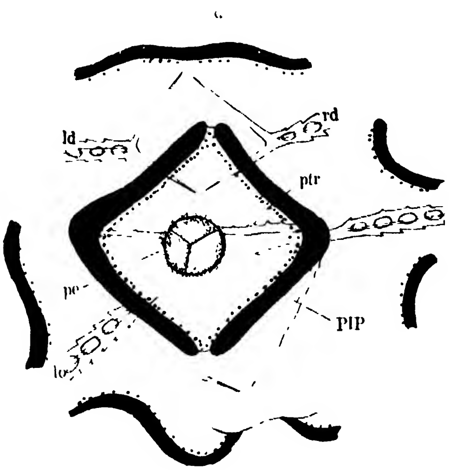

Fig. 8. *Mespilia globulus.* Posterior surface of the pluteus, showing the V-shaped posterior lateral processes.
d, dorsal side of pluteus, plp, posterior lateral process; V, ventral side of pluteus; Other legends as in preceding figs. Camera lucida drawing. ca. ×100.

The full-grown larva is formed in about 30 days after insemination; it measures ca. 1.6 mm including the antero-lateral arms (ala).

The 40-days old larva is shown in Pl. XII, fig. 2. The posterior transverse rod (ptr) ends in two branches, of which the lower one is provided with a series of 2–3 thorns along its lower edge. The well-developed posterior lateral process (plp) has a V-shaped appearance when viewed from the posterior end of the larva (Text-fig. 8).

This process is not fused with its fellow on the median line of the body, contrary to the case in the *Heliocidaris* larva. In this stage the ventral transverse rod becomes free loosing the connection with its fellow on the median line of the body. The four main arms are very slender.

About 40 days after insemination the larva enters into the stage of metamorphosis. Three pedicellariae (pe) make their appearance exactly in the same positions and in the same order as in the *Heliocidaris* larva.

Toxopneustes pileolus (Lamk.)

This species is fairly common in Japanese waters. In the vicinity of Goza, Shima Province, it is found on the sea-bottom covered with eel-grass, about five to ten fathoms deep.

The long duration of the breeding period of the present species deserves special attention. In both April and July 1930 I found ripe specimens in the waters of the Seto Marine Biological Laboratory. In Goza Bay ripe specimens were secured both in May and August 1932. Thus the breeding period of this sea-urchin extends over at least four months.

The development of this species was studied by Mortensen first in 1921 at the Misaki Marine Biological Laboratory, but the larvae did not develop beyond the first larval stage. Afterwards in 1931 he repeated the culture at

Cannoniers Point, Mauritius, but the larvae were killed by the polluted water when they reached the second stage. In my culture (1933) the larvae reached their final stages; however, they did not metamorphose, although they lived for more than eight weeks.

The egg is highly transparent and measures ca. 0.08 mm in diameter in the preserved state. The blastula is formed in about six hours; it is spherical in form, measuring 0.3 mm in diameter. The migration of the primary mesenchyme cells (pm) into the blastocoele was observed at the age of 15 hours; soon afterwards the cells scatter throughout the blastocoele (Pl. XII, fig. 3). The complete gastrula, provided with two triradiate spicules (trr), was obtained in 42 hours (Pl. XII, fig. 4).

The skeleton is somewhat spinous and of a simple basket structure, the recurrent rod being simple (rr). The elongated body rods (br) and the ventral transverse rods (vt) are thickened at the end, where they meet each other; the postoral rod (lo) is fenestrated (Pl. XII, fig. 5).

Special mention should be made of the ventral transverse rod. In the early stage, the rod is not connected with its fellow on the median line of the body (Mortensen, 1921 and Onoda, 1929), being only slightly attached to it. In the latter part of this early stage the rod becomes connected firmly with its fellow as just mentioned. When the larva is about to enter the third stage, the rods are again separated from each other at the same place, as is the case with other species.

The full size of the first stage was reached on the sixth day. The body measures ca. 0.54 mm including the postoral arms. It is scarcely truncated posteriorly and rather sparsely pigmented. The stomach is yellowish in colour. The rudiments of the dorsal arch (da) and the fenestrated postero-dorsal rods (ld) appeared successively on about the 12th day (fig. 6). In Mortensen's larva of the corresponding stage the postero-dorsal rods were simple and not fenestrated as in the present larva (1931). On the 15th day the larva entered the beginning of the second stage characterized by the appearance of the postero-dorsal arms (pd) (Pl. XII, fig. 6). The posterior end of the body is characteristically rounded; the postoral arms (pa) are much expanded laterally at their bases, and deep sinuation is found between the postoral arms and the posterior ciliated band (pb). The absorption of the skeleton sets in at the posterior end of the body rods.

The beginning of the third stage, characterized by the appearance of the preoral arms (pr), was reached on the 17th day (Pl. XII, fig. 7). The larva is provided with a rudiment of the posterior transverse rod (rp) and the epaulets (ep) are beginning to develop.

At the age of 20 days the larva has reached its full shape. It measures ca. 0.9 mm including the antero-lateral arms (Pl. XIII, fig. 1, ala). The appearance of the pedicellariae (pe) is the first indication of metamorphosis. The larva is provided with an epaulet (ep) at the base of each of the four main arms and with two pedicellariae in the posto-median groove. The secondary lateral processes of the dorsal arch are missing. The yellowish pigments grow

very numerous throughout the body; the larva thus becomes deep yellow in colour; also yellowish green patches (yp) are found near the ends of the four main arms. The posterior transverse rod (ptr) and the posterior lateral processes (plp) resemble those of the *Mespilia* larva.

The four main arms are relatively very broad, and are narrowed very abruptly at their ends.

Echinostrephus moralis A. Ag.

This species is rather uncommon in Japanese waters, but some specimens may be found in shallow waters on the rocky beaches surrounding the Seto Marine Biological Laboratory. Here the animal is found among the shoals of *Heliocidaris crassispina* and is very difficult to distinguish from the latter on account of the close resemblance of the coloration of the spines, except for the presence of a white band at the tip. The sea-urchin lives in a hole which is dug apparently by itself in accordance with its form and size. The depth of the hole is greater than the length of the body.

The animal retreats suddenly toward the bottom of the hole if one touches it. Therefore to collect the animal the rock surrounding the hole must be broken. As far as I have been able to ascertain the development of the present species has never been studied.

This species is a summer breeder. The egg measures ca. 0.15 mm in diameter and is yellowish brown in colour, not very transparent. A fertilization membrane is formed within two minutes after insemination and the two-cell stage is completed in about one hour. The segmentation shows no peculiarity.

The swimming blastula-stage was reached in five hours; it has a spherical shape. The migration of the primary mesenchyme cells (pm) into the blastocoel was seen in 12 hours (Pl. XIII, fig. 2).

The complete gastrula is represented in Pl. XIII, fig. 3, in which two triradiate spicules (trr) are seen.

The prisma larva was reached at the age of 22 hours after insemination (Pl. XIII, fig. 4). The young pluteus stage was reached at about the second day (Pl. XIII, fig. 5). The larva is greenish yellow in colour scattered with red pigment cells throughout the body. The stomach is yellowish in colour. The body skeleton forms a compound basket structure; there are two recurrent rods (primary and secondary, p'r, ar). The body rod is spinous; the postoral rod (lo) is fenestrated. The body rods (br) and the ventral transverse rods (vt) are broadened at their ends which are fused together. The posterior end of the body is truncated.

The larva died at too early a stage to permit measuring the relative length of the postoral and body rods.

Temnopleurus toreumaticus (Klein)

This species is fairly common in Japanese waters. In the vicinity of Goza,

Shima Province, it occurs on gravel bottom ca. two fathoms deep. The breeding season of this species in this locality extends from July to August. The egg is very transparent, therefore this species is very favorable for the study of the early stages.

The study of the development of the present species was undertaken by Mortensen at the Misaki Marine Biological Laboratory and the larval stage was traced as far as the second stage (1921). The culture at Goza was successful and the larvae had reached the final stage of pluteus at the time of my departure from there because of my teaching duties.

The egg measures ca. 0.08 mm in diameter in the preserved state. The full-sized larva of the first stage reaches ca. 0.4 mm including the arms (Pl. XIII, fig. 6). There is a simple recurrent rod (rr) and the body skeleton forms the non-basket structure; the postoral rod (lo) is fenestrated. The ventral transverse rods (vt) cross each other; the body rod (br) is elongated and delicately spinous. The body is scarcely truncated posteriorly and the pigmentation is very scarce. Pl. XIII, fig. 7 represents the almost fully developed larva of the third stage at the age of 25 days. It shows the postero-dorsal and the preoral arms (pd, pr); the postero-dorsal rod (ld) is fenestrated.

Four ciliated epaulets (ep) exist at the bases of the main arms and the secondary lateral processes of the dorsal arch are not developed. The posterior transverse rod (ptr) furcates into two branches at either end, and there are a pair of small ear-shaped lateral processes (plp). The main arms are fairly broad, and do not develop the yellowish green patches near the ends of the main arms.

Tripneustes gratilla (Linn.)

This species is rather uncommon in the waters of Japan proper. In the vicinity of the Seto Marine Biological Laboratory, however, we can collect the animal very easily; the ripe specimens are found in July-August.

The development of the present species was studied by Mortensen (1921, 1931). However, his paper does not include the figures of the larvae in the early stages.

The egg is rather transparent and measures ca. 0.09 mm in diameter. The fertilization membrane was formed three minutes after insemination and the two-cell stage was obtained in one hour.

Pl. XIII, fig. 8 represents the gastrula at the age of 30 hours. It is very transparent with a yellowish ground colour and has only a few scattered pigment cells.

The fully developed first stage of the pluteus is reached on the fourth day (Pl. XIII, fig. 9). It measures ca. 0.5 mm including the postoral arms. The body is distinctly truncated posteriorly. There is a simple recurrent rod (rr); the body skeleton forms a simple basket structure and is quite smooth. The ventral transverse rod (vt) connects with its fellow; the postoral rod (ro) is fenestrated. There is an elongated body rod (br).

Diadema setosum Gray

This species is found often in large numbers in shallow waters in calm inlets. Occasionally we find among the flock specimens having spines with alternate bands of purple and white. This, however, is no more than mere colour variation.

The development of the Diadematid was worked out by Mortensen, in *D. antillarum* Phil. at Tobago B. W. I., in March 1916, and the early stage was described (1921).

In July 1927 I had an opportunity of trying artificial fertilization in *D. setosum* at the Seto Marine Biological Laboratory. The description of the skeletal type of an early stage has been published elsewhere (1929). More recently (1931) an account of the development of the present species was published by Mortensen and the reconstruction of the larval skeleton in the early stage is described as a characteristic feature of this species. The larvae, in this case, entered the stage when the rudiment of the dorsal arch appeared.

According to my experience in Goza, Seto and Katsu-Ura, the breeding season of this species is in summer, from July to September. Artificial fertilization was performed at Goza on August 19; and the culture of the larvae was continued for about twenty days until I was obliged to leave the laboratory because of my teaching duties.

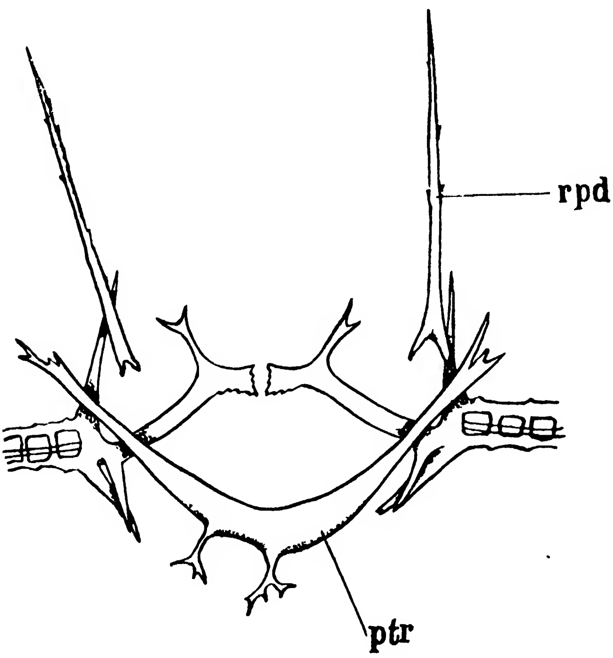

Fig. 9. *Diadema setosum*. Skeleton of the larva, showing the rudimentary posterodorsal rods, and the bow-shaped posterior transverse rod (dorsal view).
rpd, rudimentary postero-dorsal rod: Other legends as in preceding figs. Camera lucida drawing. ca. ×200.

The body skeleton has the simple basket structure; the recurrent rod (rr) is simple and the ventral transverse rod (vt) connects with its fellow. The postoral rod is fenestrated (lo); the body rod (br) is short and the body is distinctly truncated posteriorly (Pl. XIII, fig. 10).

My observation has revealed that the rudiments of the postero-dorsal rods appear as simple rods (Text-fig. 9 rpd), but the postero-dorsal arms do not develop at least until the antero-lateral arms

have been absorbed (Pl. XIII, fig. 11). It seems likely, then, that in the present larva the postero-dorsal arms have disappeared and also the preoral arms which are to be formed by the extension of the dorsal arch have met the same destiny.

Thus, the present larva represents a degenerated state in the development of sea urchins. More peculiarities are to be seen in the fact that the posterior transverse rod (bow-like) (Pl. XIII, fig. 11, text-fig. 9, ptr), which in many other species comes into existence rather as the last element of the larval skeleton, precedes the appearance of the postero-dorsal rods and the dorsal arch, and also in that neither the epaulets nor the vibratile lobes differentiate in the posterior ciliated band (pb).

The lateral processes of the dorsal arch and the posterior lateral processes are not formed. The arms of the larva are very narrow.

Strongylocentrotus pulcherrimus (A. Ag.)

This species is found most commonly in Japanese waters, occurring generally under the rocks in shallow water.

The development of the present species has been studied by Mortensen (1921) and M. Kume (1929), and the third stage of pluteus was obtained by the latter.

Fertilization was carried out on the 6th of March at the Seto Marine Biological Laboratory. Swimming blastula with a thick blastoderm developed in about 13 hours after insemination (Pl. XIV, figs. 1 and 2). The complete gastrula with two triradiate spicules (trr) was formed in about 26 hours (Pl. XIV, fig. 3). The young pluteus aged about 50 hours is shown in Pl. XIV, fig. 4, and the slightly advanced pluteus aged 65 hours may be seen in Pl. XIV, fig. 5. The fully developed pluteus of the first stage, 5-days old, is represented in Pl. XIV, figs. 6 and 7.

The body skeleton is the non-basket structure and the recurrent rod is absent. The postoral rod (lo) is simple and the body rod (br) is long. The ventral transverse rods (vt) are separate and they do not cross or connect with each other; the body is distinctly truncated posteriorly.

The plutei represented in Pl. XIV, figs. 8 and 9 were found in a plankton sample from the sea near the Laboratory in the early part of March. The postero-dorsal rod (ld) is simple; both the postero-dorsal and the preoral arms (pd, pr) are found. The posterior transverse rod and the posterior lateral processes which are formed by the extension of the branches from the former are not developed. At the bases of the four broad main arms are found well developed epaulets (ep).

Pseudocentrotus depressus (A. Ag.)

The present form is fairly common in Japanese waters and unlike many other species has its breeding season in the late fall.

Fertilization was done on the 26th of October at Toba, Shima Province. The blastula is shown in Pl. XIV, fig. 10; the complete gastrula with two

Table showing the main distinctive features

Species / Distinctive features	*M. globulus*	*E. Mathaei*	*T. pileolus*	*E. moralis*
Body rod	non-basket structure	compound basket structure	simple basket structure	compound basket structure
Postoral rod	fenestrate	fenestrate	fenestrate	fenestrate
Length of body rod	short	short	long	unknown
Ventral transverse rod in early stage (1)	crossed	connecting	connecting (slightly attached in early stage)	connecting
Recurrent rod	simple	double	simple	double
Postero-dorsal rod	fenestrate	fenestrate	fenestrate	unknown
Lateral processes of dorsal arch	one pair	two pairs	one pair	unknown
Posterior transverse rod	bifurcate (lower branch)	not bifurcate (lower branch)	bifurcate (lower branch)	unknown
Postero-dorsal arm	present	present	present	unknown
Preoral arm	present	present	present	unknown
Epaulet	present	absent	present	unknown
Vibratile lobe	absent	present	absent	unknown
Posterior lateral process	present	present	present	unknown
Form of arm in fully developed stage (2)	broad	narrow	broad	unknown
Form of body	much truncated	not much truncated	not much truncated	much truncated

(1) In later stages the rods may become separate even if they are united in earlier stages.
(2) The difference is often inconspicuous in early stages.

triradiate spicules (trr) was reached in about 24 hours (Pl. XIV, fig. 11). At the 48-hours old stage the larva assumed the pluteus form (Pl. XIV, fig. 12).

The body skeleton is of the simple basket structure and the recurrent rod (rr) is simple. The body rod (br) is long and the arms are relatively broad; the body is scarcely truncated posteriorly. The ventral transverse rods (vt) connect with each other on the median line of the body and the postoral rod (lo) is simple. Pl. XIV, fig. 13 represents the pluteus at the age of 9 days. According to Kume, both the postero-dorsal and the preoral arms are formed, the postero-dorsal rod is simple, and the vibratile lobes develop.

of the plutei of the species described.

T. treumaticus	*T. gratilla*	*D. setosum*	*S. pulcherrimus*	*P. depressus*
non-basket structure	simple basket structure	simple basket structure	non-basket structure	simple basket structure
fenestrate	fenestrate	fenestrate	simple	simple
long	long	short	long	long
crossed	connecting	connecting	separate	connecting
simple	simple	simple	absent	simple
fenestrate	unknown	simple	simple	simple
one pair	unknown	absent	unknown	unknown
not bifurcate (lower branch)	unknown	bow-like structure	absent	unknown
present	unknown	absent	present	present
present	unknown	absent	present	present
present	unknown	absent	present	absent
absent	unknown	absent	absent	present
present	unknown	absent	absent	unknown
broad	unknown	narrow	broad	broad (in early stage)
not much truncated	much truncated	much truncated	much truncated	not much truncated

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Explanation of plates X–XIV

All figures are drawn from life by the aid of camera lucida.

List of Abbreviations

ala. antero-lateral arm
br. body rod
da. dorsal arch (rudiment)
dvb. dorsal vibratile band
dvl. dorsal vibratile lobe
ep. epaulet
flp. first lateral process
it. intestine
ld. left postero-dorsal rod
lo. left postoral rod
ot. primary ordinary tube-foot
pa. postoral arm
pb. posterior ciliated band
pd. postero-dorsal arm
pe. pedicellaria
plp. posterior lateral process
pm. primary mesenchyme cell
pr. preoral arm
p'r primary recurrent rod
prl. preoral lobe
ptr. posterior transverse rod
ra. right antero-lateral rod
rd. right postero-dorsal rod
rm. rudiment of the mouth
ro. right postoral rod
rp. rudiment of the posterior transverse rod
rpr. right preoral rod
rr. recurrent rod
SA, B, C. spine A, B, C
slp. secondary lateral process
sp. sphaeridium
sr. secondary recurrent rod
tr. tetraradiate spine
trr. triradiate spicule
ts. typical spine
tt. terminal tube-foot
vvl. ventral vibratile lobe
vt. ventral transverse rod
yp. yellowish-green patch

Plate X

Figs. 1–7. *Mespilia globulus*

Fig. 1. Pluteus, dorsal view; 6-days old. ca. ×130.
Fig. 2. The same specimen shown in fig. 7, right dorsal-lateral view. ca. ×130.
Fig. 3. Pluteus, dorsal view; eight-days old. Showing the destruction of the body rods, the rudiments of the postero-dorsal rods and the dorsal arch. ca. ×100.

Fig. 4. Pluteus, ventral view; 15-days old. The preoral arms are fairly well developed; the rudiment of the posterior transverse rod has already appeared. ca. × 100.

Fig. 5. Pluteus, 30-days old, dorsal view, just entering the stage of metamorphosis. Notice the appearance of two pedicellariae and three tetraradiate spines. ca. × 90.

Fig. 6. Pluteus in the beginning of metamorphosis, 35-days old. Of the five terminal tube-feet three are projecting. ca. × 100.

Fig. 7. The same specimen shown in fig. 6 in the process of metamorphosis, right side view. Notice that the absorption of the arms is almost completed and that many typical spines have appeared. ca. × 100.

Plate XI

Figs. 1–4. *Mespilia globulus*
Figs. 5–7. *Echinometra Mathaei*

Fig. 1. Young sea-urchin just after metamorphosis, dorsal view; 35-days old. Notice the appearance of sphaeridia. ca. × 100.

Fig. 2. The same specimen shown in fig. 1, ventral view. Of ten primary ordinary tube-feet five are developed slightly aborally relative to the terminal tube-feet. ca. × 130.

Fig. 3. Imago, three days after metamorphosis; dorsal view. ca. × 60.

Fig. 4. The same specimen as in fig. 3, ventral view. The rudiment of the mouth is seen. ca. × 60.

Fig. 5. Young larva, 27-hours old; dorsal view. ca. × 160.

Fig. 6. Pluteus, 8-days old; ventral view. ca. × 150.

Fig. 7. Pluteus, 12-days old; ventral view, showing the rudiments of the postero-dorsal rods and the dorsal arch. The absorption of the body rods is in progress. ca. × 120.

Plate XII

Figs. 1–2. *Echinometra Mathaei*
Figs. 3–7. *Toxopneustes pileolus*

Fig. 1. Pluteus, 24-days old; ventral view. ca. × 50.

Fig. 2. Pluteus, 40-days old; ventral view. Notice the appearance of three pedicellariae. ca. × 50.

Fig. 3. Blastula, 15-hours old. ca. × 200.

Fig. 4. Gastrula, 42-hours old, provided with two triradiate spicules. ca. × 130.

Fig. 5. Pluteus, about 6-days old, dorsal view. ca. × 130.

Fig. 6. Pluteus, 15-days old, provided with the rudiments of the dorsal arch and the postero-dorsal rods, ventral view. ca. × 120.

Fig. 7. Pluteus, 17-days old, provided with the rudiment of the posterior transverse rod, ventral view. ca. × 130.

Plate XIII

Fig. 1. *Toxopneustes pileolus*
Figs. 2–5. *Echinostrephus moralis*
Figs. 6–7. *Temnopleurus toreumaticus*
Figs. 8–9. *Tripneustes gratilla*
Figs. 10–11. *Diadema setosum*

Fig. 1. Pluteus, 20-days old, just beginning to matamorphose; ventral view. Two pedicellariae have appeared in the posterior end of the larva. ca. × 100.

Fig. 2. Blastula, showing the primary mesenchyme cells; five hours old. ca. × 130.

Fig. 3. Gastrula provided with two triradiate spicules. ca. × 130.

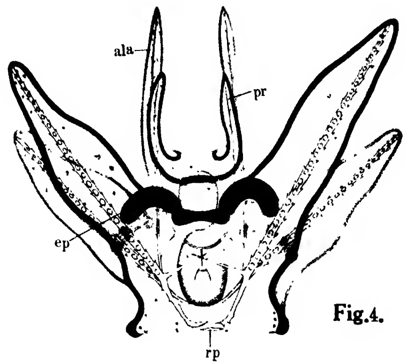
Fig. 4. Prisma larva, 22-hours old; dorsal view. ca. × 130.

Fig. 5. Young pluteus, 2-days old; dorsal view. ca. × 130.
Fig. 6. Pluteus, about one week old: dorsal view. ca. × 230.
Fig. 7. Pluteus, 25-days old; ventral view. ca. × 120.
Fig. 8. Gastrula, 30-hours old. ca. × 280.
Fig. 9. Pluteus, 4-days old; dorsal view. ca. × 160.
Fig. 10. Pluteus, about one week old; dorsal view. ca. × 110.
Fig. 11. Pluteus, 20-days old; ventral view. Notice that the preoral lobe becomes very large, bending forward, and that rudiment of the dorsal arch has appeared. ca. × 110.

Plate XIV

Figs. 1–9. *Strongylocentrotus purcherrimus*
Figs. 10–13. *Pseudocentrotus depressus*

Fig. 1. The blastula, with thick blastoderm; 13-hours old. ca. × 400.
Fig. 2. The blastula, showing beginning of formation of the gastrula; 22-hours old. ca. × 400.
Fig. 3. Gustrula, provided with two triradiate spicules; 26-hours old. ca. × 270.
Fig. 4. Young pluteus, 50-hours old; ventral view. ca. × 200.
Fig. 5. Pluteus, 65-hours old; obliquely side view ca. × 200.
Fig. 6. Pluteus, 5-days old; dorsal view. ca. × 200.
Fig. 7. The same specimen as in fig. 6, side view. ca. × 200.
Fig. 8. Pluteus, showing the beginning of the second stage, found in the plankton samples; dorsal view. ca. × 110.
Fig. 9. Pluteus in the third stage, found in the plankton samples; ventral view. ca. × 110.
Fig. 10. Blastula, showing the primary mesenchyme cells. ca. × 100.
Fig. 11. Gastrula, provided with two triradiate spicules; 24-hours old. ca. × 130.
Fig. 12. Young pluteus, 60-hours old; dorsal view. ca. × 330.
Fig. 13. Pluteus, about 9-days old; obliquely side view. ca. × 330.



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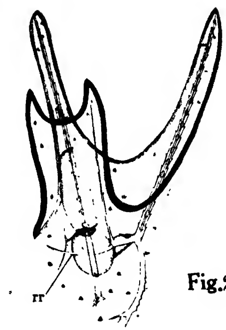

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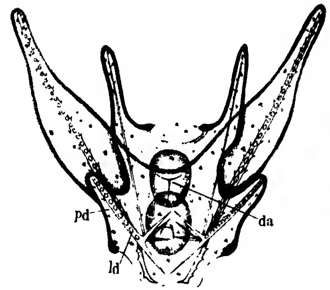

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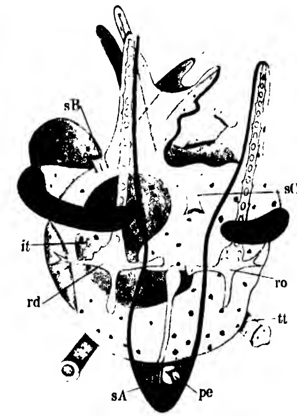

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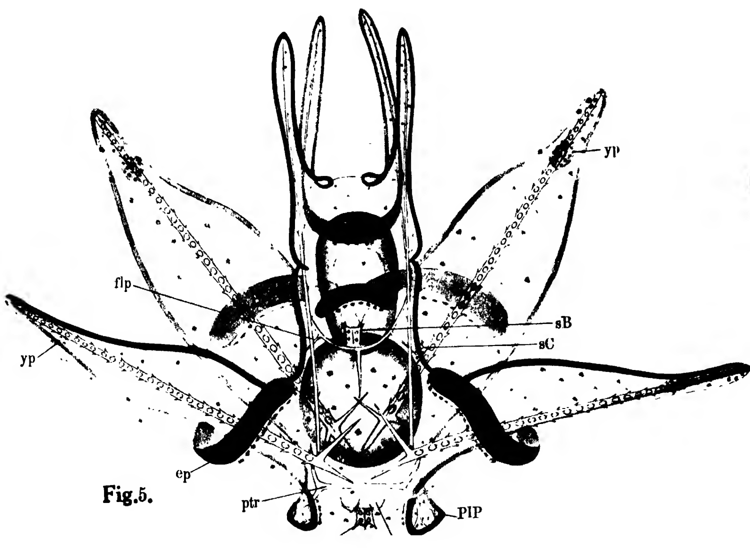

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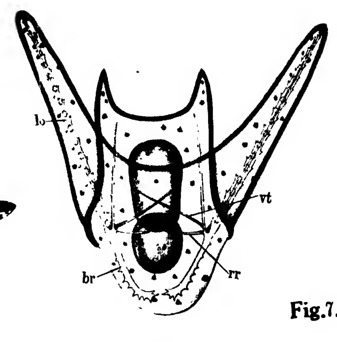

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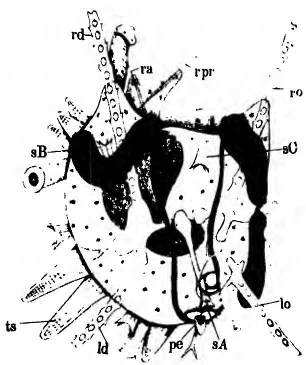

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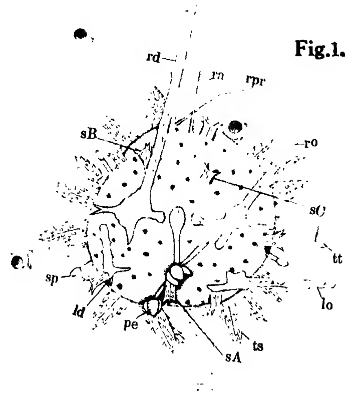

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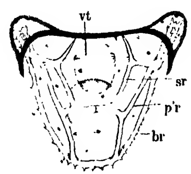

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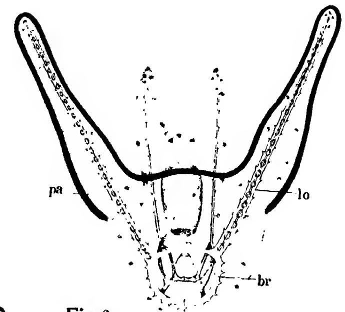

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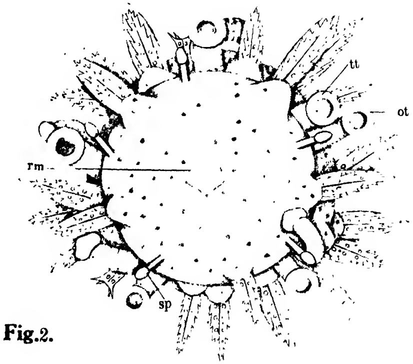

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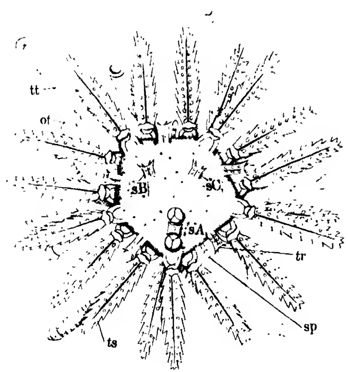

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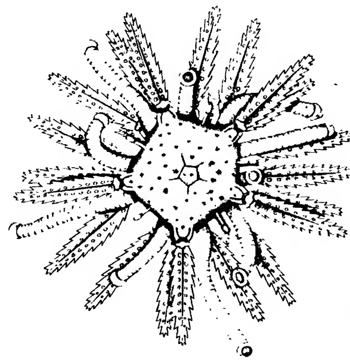

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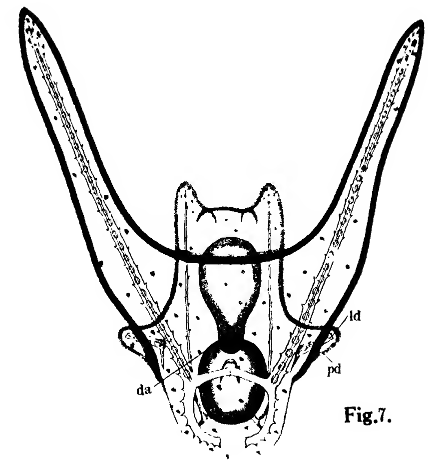

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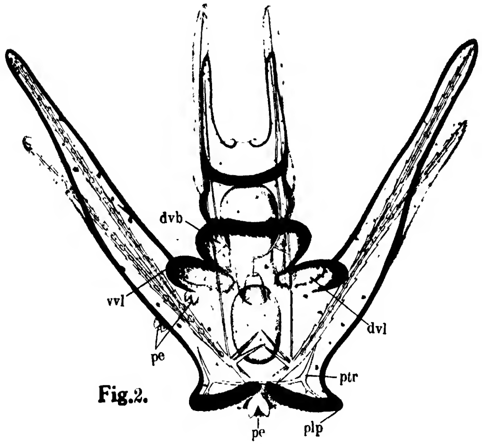

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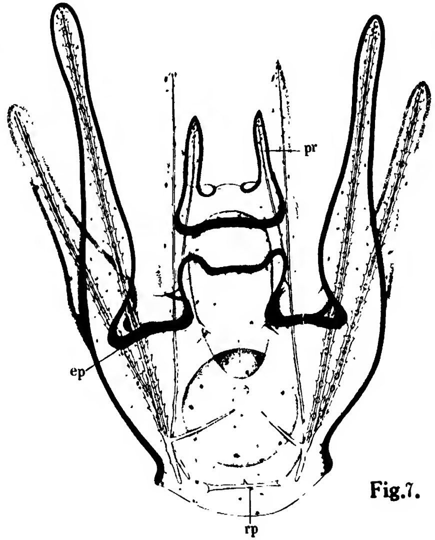

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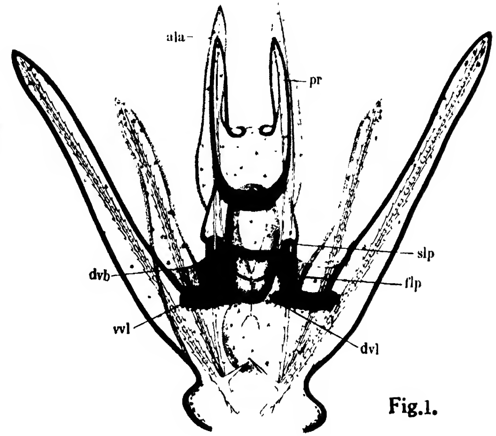

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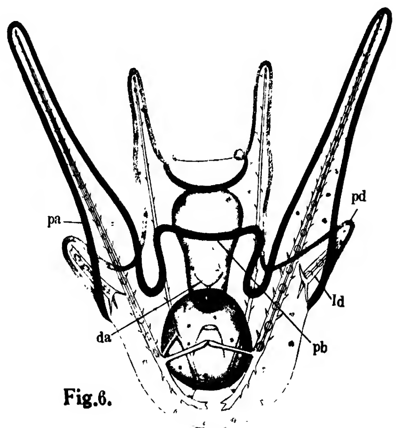

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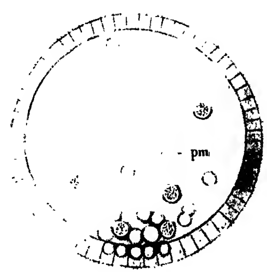

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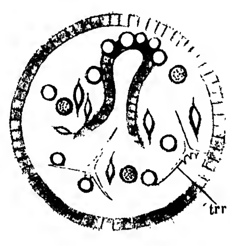

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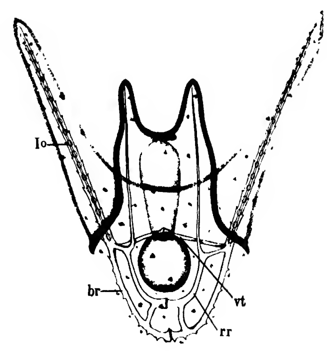

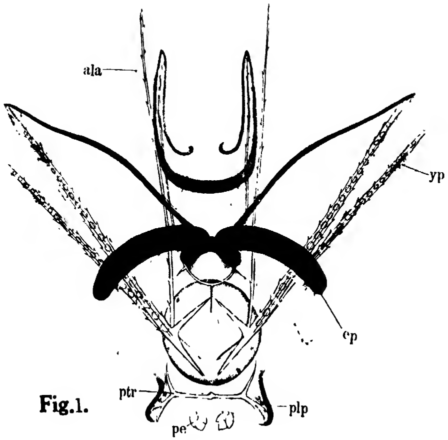

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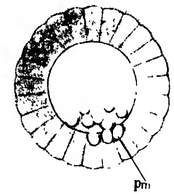

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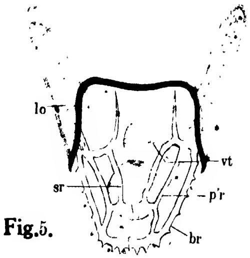

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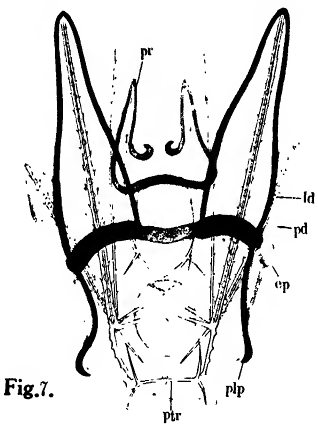

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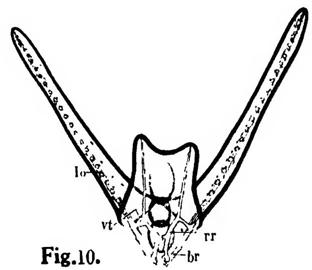

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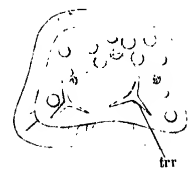

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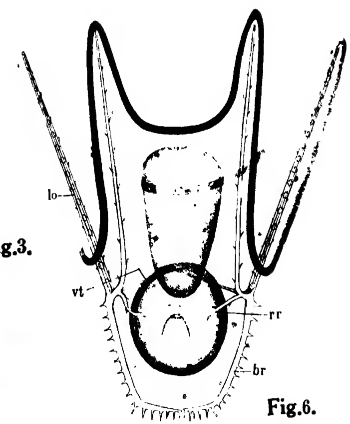

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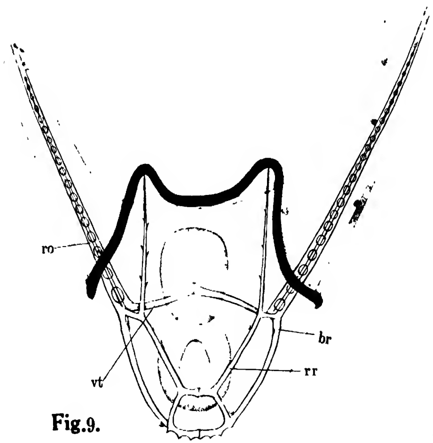

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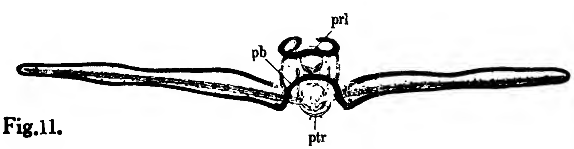

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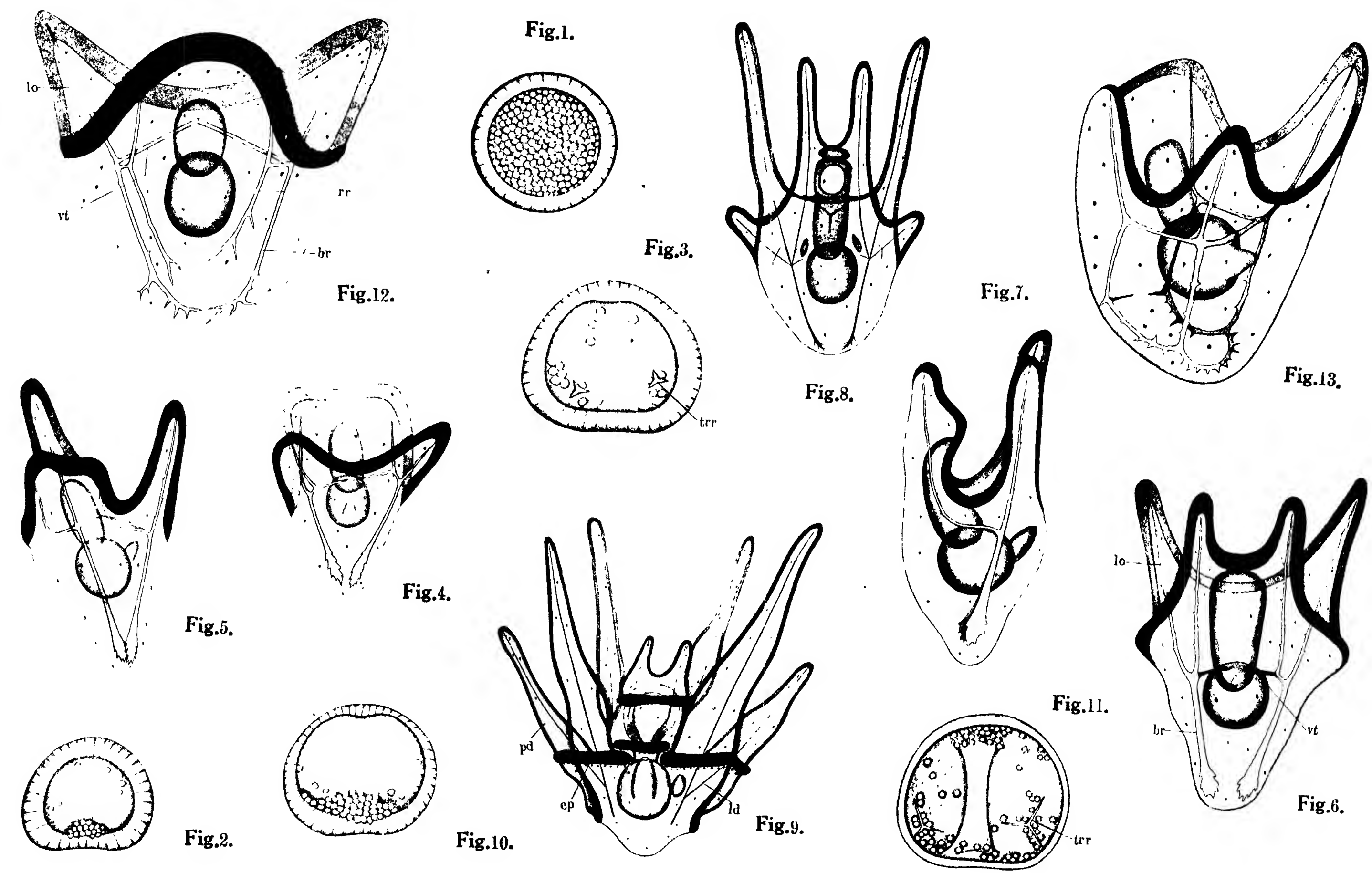
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ganous chloride) has amylolytic action, which is remarkably promoted by the addition of various oxybenzenes, such as hydrochinone, pyrocatechol etc. This indicates a close relation between diastase and oxydase as suggested by Biedermann, but his assumption that the system of diastic enzymes belongs to oxydase must be accepted with reservation, because the activity of diastase is hardly affected under anaerobic condition. Y. Kimura.

8. **Über den Einfluss der Chlorionen auf die Speichelamylase.** T. OMORI. [Jour. Biochem., **14,** No. 2 (1931), 339–342.] — Chemical combination occurs between Cl′ and amylase on activation of the latter by the former. Y. Kimura.

9. **A Colorimetric Micro Method for the Determination of Pentoses.** Kunihiko SUMINOKURA. [Jour. Biochem., **14,** No. 2 (1931), 343–359.] — A sample (containing 1.2 mg pentose) is digested at 150°C with 12.5n H_2SO_4 saturated with K_2SO_4 and containing $ZnSO_4$ as catalyser. Furfural thus formed is distilled with steam and CO_2 current and colorimetrically determined with xylidine and acetic acid. Methylpentoses, hexoses and various aldehydes have no effect upon the color reaction. Y. Kimura.

10. **Über die Urikase.** Kishun RO. [Jour. Biochem., **14,** No. 2 (1931), 367–390.] — A method to prepare the pure enzyme from the kidney of cattle; accounts of the various properties of the sample obtained are given. Y. Kimura.

11. **Über die quantitative Bestimmung des Allantoins auf kolorimetrischem Wege.** Kishun RO. [Jour. Biochem., **14,** No. 3 (1932), 391–403.] — A modification for quantitative use of the specific color reaction of allantoin discovered by Fosse and Bossyt (1929). Y. Kimura.

12. **Über die Allantoinase.** Kishun RO. [Jour. Biochem., **14,** No. 3 (1932), 405–411.] — Optimum pH 7.3, optimum temperature 50°–60°C. Y. Kimura.

13. **Über den Allantoingehalt des Harns von Neugeborenen und Schwangeren, und Amnionswasser.** Kishun RO. [Jour. Biochem., **14,** No 3 (1932), 413–417.]

14. **Über den Einfluss der Gallensäure auf Glycerophosphatase II.** Hiroshi TAKATA. [Jour. Biochem., **14,** No. 3 (1932), 439–445.] — Synthesis of glycerophosphoric acid is promoted by cholic acid, more distinctly in the kidney than in the liver. Y. Kimura.

15. **Biochemical Studies on Hydrocyanic Acid. VII. On the Cause of Hydrocyanic Acid Hyperglycemia.** Fumio KUDO. [Jour. Biochem., **14,** No. 3 (1932), 447–461.] — The hyperglycemia of prussic acid poisoning is due chiefly to the increase of adrenalin by asphyxia but partly to the increase of adrenalin-like substances in the blood, which apparently promote the action of adrenalin. Y. Kimura.

16. **Beiträge zur Kenntnis der hyperglykämischen Wirkung der Gallensäure.** Keizo TANAKA. [Jour. Biochem., **14,** No. 3 (1932), 463–473.] — Among bile acids, only those which have secondary alcohol group like apocholic acid, dehydrocholic acid and dehydrodesoxycholic acid in their molecules have hypoglycemic effect; cholanic acid and cholatrienic acid are inactive. Y. Kimura.

17. **A Micromethod for the Determination of Blood Peroxidase.** H. MASAMUNE and K. KODAMA. [Jour. Biochem., **14,** No. 3 (1932), 475–479.] — A modification of the Willstätter-Stoll method. Peroxidase in 0.01–0.007 cc of blood can be estimated without serious error. Y. Kimura.

18. **Studien über Gallensäurestoffwechsel. IV. Über den Einfluss der Bakterien und der Ultraviolett- und Röntgenstrahlen auf Gallensäuren.** Hisashi MIKAMI. [Jour. Biochem., **14,** No. 3 (1932), 489–500.]

19. Über die Phosphomonoesterase und die Phosphodiesterase. Shuichi UZAWA. [Jour. Biochem., **15**, No. 1 (1932), 19–28.] — Mono- and diesterases could be isolated from diastase. A diesterase was also obtained from the venom of *Trimeresurus flavoviridis*. Y. Kimura.

20. Über den Einfluss der Funktion der endokrinen Drüsen auf Zuckerausscheidungsschwelle. Soitiro YOKOTA. [Jour. Biochem., **15**, No. 1 (1932), 65–110.] — The threshold of sugar excretion is lowered by the adrenal medulla and the anterior lobe of the hypophysis, and raised by the adrenal cortex, the posterior lobe ot the hypophysis and the thyroid gland. Animals employed were rabbits. Y. Kimura.

21. Beitrag zur Kenntnis des Einflusses der Lichtstrahlen auf den Gesamtcholesteringehalt der Haut. S. KAWAGUCHI. [Jour. Biochem., **15**, No 1 (1932), 111–114.] — The total content of cholesterol (especially cholesterol ester) increases. The test animal was rabbit. Y. Kimura.

22. Über die anorganischen Bestandteile der Nervensubstanz. Kyo HAYASHI. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 1–5.] — Inorganic chlorine, sulphur, phosphorus, sodium, potassium, calcium and magnesium occurring in various nervous tissues of the sei and fin whales were estimated. The content of sulphur as well as of Na, Cl, Mg and Ca was far higher in the lingual nerves that in the white and gray substances of the cerebral hemisphere, the spinal cord and the cauda equina, while the phosphorus and potassium content was distinctly less in the former than in the latter. Chlorine and sodium content seems to be greater in whales than in land mammals. Y. Kimura.

23. Über den Darminhalt des Pottwals. M. SUZUKI. [Jap. Jour. Med. Sci., II. Biochem. **2**, No. 1 (1933), 7–9.] — Bile acids, cholesterol, tyrosine and arginine are undoubtedly present. Y. Kimura.

24. Über den Kationen- und Chlorgehalt des Kaninchengehirns. Matsuo MATSUMOTO. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 11–20.] — Average values are as follows: in the gray substance, 351.7±4.03 mg% K, 131.9±3.46 mg% Na and 181.9±1.30 mg% Cl; in the white sub., 6.6±0.16 mg% Ca, 16.1±0.09 mg% Ma, 340.1±5.61 mg% K, 121.7±4.11 mg% Na and 165.4±2.50 mg% Cl. The water and total N content is 81.85 and 1.95% in the gray substance and 69.42 and 2.07% in the white. Y. Kimura.

25. Untersuchungen über Cetacea. XLII. Über die Extraktivstoffe des Muskels. Teijiro YAZAWA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 37–41.] Lactic acid, adenine, hypoxanthine and kreatine have been detected in the muscle of the fin whale. Y. Kimura.

26. Untersuchungen über Cetacea. XLIII. Über die stickstoffhaltigen Substanzen der Leber. Teijiro YAZAWA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 43–46.] — Guanine and xanthine are undoubtedly present in the liver of the sei whale, but the presence of adenine and hypoxanthine is doubtful. The behavior of various nitrogen compounds in autolysis was also investigated. Y. Kimura.

27. Über den Zucker im Fruchtwasser. Beobachtungen am Fruchtwasser des Hühnerembryos. Kichinosuke YAMADA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 47–69.] — Fructose was distinctly detected in the aminotic and allantoic fluids. Physical properties and chemical constituents of the fluids were studied. Y. Kimura.

28. Über die Verteilung von Chlor in sich entwickelnden Hühnereiern. Kichinosuke YAMADA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 71–79.] - 162.6–178.7 mg of chlorine are found in fresh eggs, about three-fifths of which is in the egg white and only a trace in the shell. On the 4th to 6th day of development, however, a sudden transfer of chlorine from the egg white to the yolk occurs, then the relative amount of chlorine in the two portions remains nearly constant until the end of development, when chlorine increases again in the yolk.

The concentration of chlorine is highest in the amniotic fluid, lower in the allantoic fluid and lowest in the yolk and white. The rise and fall of chlorine in the fluid elements of the egg go parallel with their osmotic pressures. Y. Kimura.

29. **Über den Gehalt des Blutes des Hühnerembryos an Chlor, Gesamt- und Reststickstoff.** Kichinosuke YAMADA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 81-83.] — 15-20 days old embryos gave the following results: on an average, Cl=0.475%, reducing substances=0.130% as glucose, total N=1.255% and residual N=9.961%.
Y. Kimura.

30. **On the Inorganic and Phosphagen Phosphorus Content of the Brain.** Matsuo MATSUMOTO. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 85-91.] — Phosphagen phosphorus content is higher in the white than in the gray matter of rabbits and albino rats. Inorganic phosphorus content however is higher in the gray than in the white matter. The influence of different modes of killing and of sampling of material upon the analytical results is noticed. Y. Kimura.

31. **Über das Vorkommen von Lävulose im Fruchtwasser des Hühnerembryos.** Kichinosuke YAMADA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 108-113.] — Besides glucose, fructose was isolated from the amniotic and allantoic fluids. In embryos 2 weeks old it forms 1/13-1/15 of the total sugar. It was also found even in fresh eggs in small quantity.
Y. Kimura.

32. **Untersuchungen über Maltose.** Takeo KOKURYO. **I. Über die Blutmaltase.** [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 1 (1933), 115-130.] **II. Über die Herkunft der Blut- und Harnmaltase.** [Ditto, 131-159.] **III. Einige Wirkungsbedingungen der Maltase des Blutserums.** [Ditto, 161-174.] — I. Maltase is present in the sera of the pig, dog, horse and ram but not in those of the cat, guinea pig, rabbit and man. It occurs in the serum, not in red corpuscles, and fractionates mainly with pseudoglobulin. II. Maltase is detectable in the normal urine of dog. The maltase of the blood and urine seems to originate partly from the pancreas and partly from the intestine, but has no relation to the liver. Diastase comes also from the pancreas. III. Sodium fluoride (0.5%) used as antiseptic promotes the action of serum maltase much. Sodium chloride (0.9%) acts also as an activator. Optimum pH 6.6.
Y. Kimura.

33. **Untersuchungen über Cetacea. XLIV. Über isoelektrische Ausflockung von Porphyrinen.** Yoshio OKAHARA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 189-194.] — Precipitation optima of hematoporphyrin pH 3.9 and 4.2, of uroporphyrin pH 2.2 and 2.9, of amber porphyrin from whales pH 3.2 and 3.8. Y. Kimura.

34. **The Micro-determination of Oxalic Acid in Blood.** Shoichi IZUMI. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 195-204.] — Oxalic acid in blood is precipitated as cerium oxalate instead of the usual calcium oxalate and the cerium salt collected and washed is dissolved in sulfuric acid and titrated with permanganate solution. Oxalic acid as little as 0.042 mg can be estimated with accuracy by this method. Another colorimetric method is also described. Y. Kimura.

35. **On the Creatine in Brain.** Matsuo MATSUMOTO. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 205-213.] — The creatine value for the brain given so far in the literature is higher than actual, because of the presence of other chromogenic substance in the ether extract of the brain. 80-90 mg of creatine is actually present in 100 g of brain tissue.
Y. Kimura.

36. **Beiträge zur Kenntnis der Diazoreaktion, insbesondere der im Blut.** Gitaro NAKAYAMA. (Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 215-227.] — The blood of man, dog, cat, horse, cattle, sheep, rabbit, rat, hen, pigeon, toad, frog, tortoise, carp, plaice and bonito shows the Leimdörfer-Charnass diazoreaction. The substance responsible for it seems to

be present in erythrocytes and not in plasm or serum. Bilirubinemia or urobilinemia and the residual nitrogen of the blood have no connection with this reaction, nor fever nor inanition. It is easily prevented by alkali but not by acids. Y. Kimura.

37. **Beiträge zur Kenntnis der Diazoreaktion, insbesondere der im Blut.** Gitaro NAKAYAMA. **II. Träger der Diazoreaktion im Serum und Harn.** [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 229-235.] **III. Träger der Diazoreaktion der roten Blutkörperchen.** [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 237-244.] — II. The cause of the Andrewes diazoreaction of serum is attributed to urochromogen, indoxyl compounds and another unknown substance (probably a imidazol derivative). III. Ergothionein is the chief carrier of the reaction. Y. Kimura.

38. **Über den Zuckergehalt des Samens.** Kichinosuke YAMADA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 245.] — Three samples of human sperm gave 62.5 mg, 140 mg and 83 mg of sugar per 100 cc respectively. Y. Kimura.

39. **Studies in the Biochemistry of Copper. II. The Copper Content of the Blood with a Method for its Determination.** Uichiro SAHARA. [Jap. Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 261-275.] — A new macro method for determining copper in the blood. The color reaction employed is sensitive enough to prove copper in 1 cc of blood. The copper content is higher in ox and horse than in man, pig or rabbit; it is higher in marine than in freshwater fishes. Moreover, the more active fishes (*Lateolabrax*, sea-belly and *Carassius*) have higher copper content than less active ones (*Sebastodes*, plaice and *Parasilurus*). It varies in different species but individual variations have narrow limits. The chief carrier of copper seems to be the erythrocytes. Y. Kimura.

40. **Über den Kohlenhydratgehalt von Leber und Muskel der Wild- und Hausente.** Saburo SUZUKI. [Jap Jour. Med. Sci., II. Biochem., **2**, No. 2 (1933), 277-283.] — In the wild duck the carbohydrate content of the liver decreases distinctly in February and March but that of the muscle remains nearly constant. In the domesticated duck however, seasonal variation can hardly be seen. Y. Kimura.

41. **Über den Angriffspunkt des Pilocarpins, der am isolierten, künstlich gespeisten Herz-Nervenpräparate der Kröte untersucht wurde.** Kosuke FURUTA. [Jap. Jour. Med. Sci., IV. Pharmac., **7**, No. 2/3 (1933), 113-131, 5 Taf.] — Pilocarpin attacks synaptic junctions and postganglionic portions. Perfusion with weaker doses of pilocarpin (1:1,000,000-1:5,000,000) gives rise to excitation of the synapses in the vagus ganglion but stronger doses (1:100,000-1:10,000) cause paralysis not only of synapses but also of postganglionic neurons. Tigropyknosis is seen in the former case and tigrolysis in the latter. Y. Kimura.

42. **Fauna of the Thysanoptera in Japan. (Part III).** Masato ISHIDA. [Ins. Mats., **7**, No. 1/2, (1932), 1-16, 1 pl.] — Descriptions of 6 new species: *Idolothrips kawamurai, I. yashiroi, Machatothrips femoralis, M. isshikii, M. ohtai,* and *M. ipomoeae.* S. Kuwayama.

43. **The Dytiscidae of Japan. Part I (Noterinae, Laccophilinae).** Motomu TAKIZAWA. [Ins. Mats., **7**, No. 1/2 (1932), 17-24, 1 fig.] — Five species of Noterinae and 6 of Laccophilinae are enumerated; one new species, *Laccophilus formosanus*, is described. S. Kuwayama.

44. **Über einige Ichneumoniden Arten Japans. (1).** Toichi UCHIDA. [Ins. Mats., **7**, No. 1/2 (1932), 25-32, 1 Fig.] — Notizen über 1 Gattung, 12 Arten und 4 Formen. Neue Arten: ***Gathetus flavibasalis, Hoplismenus miokensis, Stenichneumon odaiensis, Amblyteles sonani*** und ***Heresiarches heinrichi.*** Neue Formen: *Callajoppa pepsoides* f. ***tomarii*** und *Eupalamus lamentator* f. ***annulatus.*** S. Kuwayama.

45. **Lasiocampid-Moths in the Japan-Empire.** Shonen MATSUMURA. [Ins. Mats., **7**, No. 1/2 (1932), 33-54, 1 fig.] — An enumeration of 55 species under 26 genera, including 2 new genera and one new species. Besides, 8 new local forms are described. New genera:

Karenkonia (type *K. taiwana* Matsumura) and *Pseudarguda* (type *Arguda formosae* Wileman). New species: *Karenkonia taiwana.* New Forms: *Gastropacha populifolia* f. *japonica, Kanugia ampla* f. *kimadara, K. ampla* f. *kusari, K. ampla* f. *usuguronis, Malacosoma neustrium* f. *coreana, M. neustrium* f. *formosana, M. neustrium* f. *takamukui,* and *Selenephera lunigera* f. *sachalinensis.*
S. Kuwayama.

46. Beitrag zur Lyciden-Fauna Japans. Hiromichi KÔNO. [Ins. Mats., 7, No. 1/2 (1932), 54-64, 2 Fig.] —Notizen über 1 neue Gattung, 1 neue Untergattung, 4 neue Arten, 1 neue Unterart und einige bisher bekannte Arten, mit einer Liste der geographischen Verbreitung der japanischen Arten. Neue Gattung: *Chuzenjianus* (Typus *C. tenuis* Kôno). Neue Untergattung: *Benibotarus* (Typus *Dictyopterus spinicoxis* Kiesenwetter). Neue Arten: *Dictyopterus sapporensis, Aplatopterus septentrionalis, Platycis otome,* und *Chuzenjianus tenuis.* Neue Unterart: *Platycis nasuta taiwana.*
S. Kuwayama.

47. Die Callidiopinen von japanischen Reich (Col. Ceramb.). Masaki MATSUSHITA. [Ins. Mats., 7, No. 1/2 (1932), 65–73, 5 Fig.] — Beschreibungen von 17 Arten unter 5 Gattungen. Neue Gattung: *Paraceresium* (Typus *P. saipanicum* Matsushita). Neue Arten: *Ceresium fuscum* Matsumura et Matsushita, *C. hachijoense* Matsumura et Matsushita, *C. japonicum* Matsushita, *C. signaticolle* Matsumura et Matsushita, *Paraceresium saipanicum* Matsushita, und *Trinophylum boninense* Matsumura et Matsushita. Neue Aberratio: *Stenygrinum quadrinotatum* Bates ab. *conjunctum* Matsushita.
S. Kuwayama.

48. Notes on Braconidae of Japan. III. *Apanteles.* Chihisa WATANABE. [Ins. Mats., 7, No. 1/2 (1932), 74–102, 6 figs., 1 pl.] —Record of 29 species and 1 form, with host index. New species: *Apanteles suzumei, A. tatehae, A. planus, A. sasakii, A. kuwayamai, A. sugae, A. hamakii, A. sonani, A. igae,* and *A. asotae.* New name: *A. miyoshii* for *A. smerinthi* Miyoshi and *A. okamotoi* for *A. smerinthi* Okamoto.
S. Kuwayama.

49. Über die neuen Cerambyciden-Arten Japans. Masaki MASTUSHITA. [Ins. Mats., 7, No. 3 (1933), 103–110, 6 Fig.] — Beschreibungen von 13 Arten. Neue Arten: *Pidonia orientalis, Leptura sachalinensis, Strangalia coreana, St. doii, Anaglyptus bellus* (Matsumura et Matsushita), *A. sapporensis, Pterolophia coenosa, Exocentrus bioculatus* (Mats. et Matsus.), *Exocentrus fujiyamai* (Mats. et Matsus.), *Glenea daisenensis,* und *Glenea hachijonis* (Mats. et Matsus.). Neue Unterart: *Abryna coenosa loochooana.* Neue Varietät: *Mimistena setigera* Schwarzer var. *ruficollis.*
S. Kuwayama.

50. Lymantriidae of Japan-Empire. Shonen MATSUMURA. [Ins Mats., 7, No. 3 (1933), 111–152, 1 pl.] — An enumeration of 166 species under 27 genera, including 11 new species and 3 new genera. New genera: *Chibidokuga* (genotype *Dasychira nigra* Hampson), *Maimaia* (genotype *Ocneria furva* Leech) and *Medama* (genotype *Euproctis diplaga* Hampson). New species: *Aroa coreana, Dasychira nagoyana, Euproctis kan, E. postalbata, E. shironis, E. usukia, Lymantria bantaizana, L. minomonis, Orgyia nantonis, Porthesia hopponis,* and *P. mimosa.* New forms: *Dasychira fasceline* Linné f. *karafutonis, Euproctis niphonis* Butler f. *kuronis, E. niphonis* f. *postalbata, Lymantria dissoluta* Strand f. *takasagonis, Orgyia antiqua* Linné f. *manchurica,* and *Porthesia similis* Fuessly f. *coreacola.*
S. Kuwayama.

51. Über die Schmarotzerhymenopteren von *Grapholitha molesta* Busck in Japan. Toichi UCHIDA. [Ins. Mats., 7, No. 4 (1933), 153–164, 5 Fig.] — Beschreibungen von 14 Arten und 2 Formen unter 4 Unterfamilien aus Japan; darunter 5 Arten, *Habrocryptus yagoi, Spilocryptus grapholithae, Hemiteles (Isadelphus) molestae* und *Hemiteles (Nipponaëtes) haeussleri,* und eine Form, *Pristomerus vulnerator* Panzer f. *erythrothoracis,* für die Wissenschaft neu sind. Eine Untergattung, *Nipponaëtes* (Typus *Hemiteles haeussleri* Uchida), und eine Gattung, *Plectochorus* (Typus *Mesochorus iwatensis* Uchida), sind neu.
S. Kuwayama.

52. The Dytiscidae of Japan. Part II (Hydroporinae). Motomu TAKIZAWA. [Ins. Mats., 7, No. 4 (1933), 165–179.] — Of twenty-three species enumerated, referable to 4 tribes and 8 genera, 4 species are described as new: *Hydrovatus japonicus, Hydroporus saghaliensis,*

H watanabei and *Deronectes (Potamodytes) nipponicus.* S. Kuwayama.

53. On Two New Species of Braconidae bred from Some Curculionid-larvae in Japan. Chihisa WATABABE. [Ins. Mats., **7**, No. 4 (1933), 180–181.] — Descriptions of *Bracon apoderi* and *Calyptus byctisci.* S. Kuwayama.

54. Die Hylobiinen aus Formosa (Col. Curc.). Hiromichi KÔNO. [Ins. Mats., **7**, No. 4 (1933), 182–189.] — Beschreibungen von 11 Arten unter 5 Gattungen. Neue Gattungen: *Dysceroides* (Genotypus *D. bipustulatus* Kôno) und *Kobuzo* (Genotypus *Hylobius rectirostris* Roelofs). Neue Arten: *Aclees taiwanensis, A. hirayamai, Hylobius niitakensis, H. kanoi, H. minowai, H. pustulatus, Dysceroides bipustulatus,* und *Kobuzo kikuchii.* S. Kuwayama.

55. New Species of Cymatophoridae of Japan and Formosa. Shonen MATSUMURA. [Ins. Mats., **7**, No. 4 (1933), 190–201. 1 fig., 1 pl.] — Descriptions of 8 new species and 13 new genera as well as re-descriptions of 11 species which were originally described in the author's "6000 Illustrated Insects of Japan" (1931). New genera: *Baipsestis* (genotype *Parapsestis baibarana* Matsumura), *Episaronaga* (genotype *Cymatophora albicostata* Bremer), *Exothyatira* (genotype *Thyatira flavida* Butler), *Formotogaria* (genotype *F. shirakii*), *Horipsestis* (genotype *H. teikichiana*), *Horithyatira* (genotype *Thyatira decorata* Moore), *Misthyatira* (genotype *Thyatira aurorina* Butler), *Neodaruma* (genotype *N. tamanukii* Matsumura), *Neopsestis* (genotype *Polyploca nikkoensis* Matsumura), *Neotogaria* (genotype *N. saitonis* Matsumura), *Sugiploca* (genotype *S. sugitanii* Matsumura), *Suzupsestis* (genotype *Parapsestis albida* Suzuki), and *Takapsestis* (genotype *T. wilemaniella* Matsumura). New species: *Baipsestis tomponis, Horipsestis teikichiana, Neodaruma tamanukii, Neoploca misaona, Palimpsestis akanensis, P. hirayamai, Sugiploca sugitanii,* and *Takapsestis wilemaniella.* New form: *Thyatira batis* f. *formosicola.* S. Kuwayama.

56. Studies on the Morphology and Ecology of the Rice Leaf-beetle, *Lema oryzae* Kuwayama, with Special Reference to the Taxonomic Aspects. Satoru KUWAYAMA. [Jour. Fac. Agr., Hokkaido Imp. Univ., **33**, Pt. 1 (1932), 1–132, 4 pls., 13 figs.] — Results of detailed studies on *Lema oryzae* in Japan during the last ten years, giving a historical sketch, morphology of all stages, ecology, taxonomy, distribution and original home, natural enemies, controlling measures, etc. This species is one of the most serious and widely distributed among one hundred and seventy insect pests of rice-culture, and has been known since 1826. This species was formerly called *Lema melanopa* Linné or *L. tristis* Herbst (=*L. flavipes* Suffrian), but the name *L. oryzae* given by the author in 1931 is discussed in detail in this paper. *L. tristis* occurs very rarely in various parts of Japan proper; the occurrence of *L. melanopa* in Japan is doubtful, reports of its presence in Honshû probably referring to *L. oryzae*, and all reliable records of *L. tristis* and *L. melanopa* on rice throughout Japan refer to *L. oryzae.* A synopsis with key is given of 19 valid species and 3 varieties of *Lema* recorded in Japan, including one new species (*L. formosana*) and three new varieties (*L. concinnipennis* Baly var. *ventralis*, *L. diversa* Baly var. *doii* and *L. decempunctata japonica* Weise var. *brunneipennis*). Notes, with key, on the bionomics and distribution of the five palaearctic species of the genus attacking graminaceous plants are also given, together with comparative morphology and bionomics of *L. oryzae* and *L. melanopa.* The dimensions of the adult, egg, larva, pupa and cocoon vary considerably according to individuals; the female is much larger than the male. The size difference between the sexes appears at the pupal stage, female pupa being much larger and more elongate than the male. There is only one generation in a year. The adults, which live for a year or more, hibernate soon after emergence in late July and August in debris, or among the roots of grasses, which they leave in late May, mate, and oviposit from early June to late July; in Taiwan, the life-cycle proceeds about 3 months earlier. The eggs are deposited in masses generally on the upper surface of rice plant leaves, one mass containing 1–46 eggs; incubation period 5–11 days according to temperature; larval period 13–19 days; pupation on leaves and on or in the soil. Both adult and larva eat leaves, leaving parallel longitudinal stripes in the upper epidermis. Rice is at present apparently the only plant on which the beetle can develop well; the adult can in the absence of rice plants feed on other cereals and grasses, but with resulting shortened life and restricted oviposition and larval life of only 3–5 days. In cases of heavy infestation the rice plant withers at no time, and even slight infestation causes retardation of growth.

This species is widely distributed in Japan throughout Hokkaidô, Honshû, Shikoku, Kyushû, Chôsen and Taiwan, but infestation by it is noticeably severer around the coast of the Sea of Japan (except Taiwan) than on the Pacific sea-board. The original home is supposed to be the coast of the Sea of Japan somewhere between Yamagata and Ishikawa Prefectures. A mymarid, *Anaphes nipponicus* sp. n., is an important egg parasite of *L. oryzae*; in 1929 and 1930, parasitism by it reached 51.5% about the end of July at Kagura, Hokkaidô. As primary larval parasites five species are enumerated, namely *Trichomalopsis shirakii* Crawford (Pteromalidae), *Anilastus japonicus* Sonan, *Nesopimpla naranyae* Ashmead, *Melcha lemae* Sonan and *Habrocryptus ruficoxatus* Sonan (all four Ichneumonidae). *T. shirakii* is widely distributed and its percentage of parasitism attained an average of 11.26% of the larvae in Oshima Peninsula; *A. japonicus* is common in Hokkaidô and Honshû and parasitised an average of 11.65% of the larvae in Oshima; *N. naranyae* is an important parasite of the rice leaf caterpillar, *Naranga aenescens* Moore, and has been reared once from *L. oryzae*. The rare ichneumonids *Pezomachus lemae* Sonan and *Bathythrix rufus* Sonan and *B. kuwanae* Viereck, which have been bred from an average of 9.75 per cent of cocoons of the beetle in Oshima, are considered to be secondary parasites of *L. oryzae*. The most important predators are the coccinellid, *Hippodamia tredecimpunctata* Linné, and the staphylinid, *Paederus idae* Sharp, both attacking the eggs and larvae in Japan. The former is considered to be by far the most important of the natural enemies. Some controlling measures are recommended. Author.

57. Studies on *Lema oryzae* Kuwayama, the Rice Leaf-beetle. I (Morphology and Ecology of the Rice Leaf-beetle). (Japanese.) Satoru KUWAYAMA. [Rep. Hokkaido Agr. Exp. Sta., No. 29 (1932), 1-70, 5 pls.]

58. Studies on *Lema oryzae* Kuwayama, the Rice Leaf-beetle. II (On the Distribution of the Rice Leaf-beetle). (Japanese.) Satoru KUWAYAMA. [Rep. Hokkaido Agr. Exp. Sta., No. 29 (1932), 71-96, 1 pl.]

59. Studies on *Lema oryzae* Kuwayama, the Rice Leaf-beetle. III (Insect Enemies of the Rice Leaf-beetle). (Japanese.) Satoru KUWAYAMA. [Rep. Hokkaido Agr. Exp. Sta., No. 29 (1932), 97-130, 2 pls.]

60. H. Sauter's Formosa-Ausbeute. Ichneumonidae (Hym.). Toichi UCHIDA. [Jour. Fac. Agr., Hokkaido Imp. Univ., **33**, Pt. 2, (1932), 133-222, 22 Fig.] — Beschreibungen von 165 Arten und 9 Formen unter 5 Unterfamilien aus Formosa, von denen 8 Gattungen, 3 Untergattungen, 64 Arten, und 4 Formen neu sind. Neue Gattungen: *Apocryptus* (Genotypus *A. issikii* Uchida), *Stenaraeoides* (Genotypus *Mesostenus octocinctus* Ashmead), *Orientohemiteles* (Genotypus *O. ovatus* Uchida), *Odontocryptus* (Genotypus *O. brillantus* Uchida), *Pseudotorbda* (Genotypus *P. geniculata* Uchida), *Dichelobosmina* (Genotypus *D. tuberculata* Uchida), *Scenocharops* (Genotypus *S. longipetiolaris* Uchida), und *Perilissoides* (Genotypus *P. cubitalis* Uchida). Neue Untergattungen: *Erythrojoppa* (Typus *Acanthojoppa* (*Erythrojoppa*) *sauteri* Uchida), *Prosopostenus* (Typus *Hemiteles* (*Prosopostenus*) *koshunensis* Uchida), und *Koshunia* (Typus *Hemiteles* (*Koshunia*) *taiwanellus* Uchida). Neue Arten: *Coelichneumon hormaleoscelus, C. sauteri, C. taihorinus, C. kosempensis, C. 10-guttatus, C. ampingensis, C. fulvibasalis, Acanthojoppa sauteri, Melanichneumon funkikonis, M. futasujii, M. tricolor, M. semicircularis, M. ramellaris, M. parvidentatus, Barichneumon suisharioensis, B. tainanensis, B. hozanensis, Amblyteles sauteri, A. kankoensis, Platylabus formosanus, P. taihorinus, Neotypus flavipes, Takanona alboannulata, Nipporicnus rufus, Cryptus tuberculatus, C. suisharionis, Apocryptus issikii, Paracryptus formosanus, Caenocryptus taihorinus, Goryphus robustus, G. horeiensis, G. kurarensis, G. suishanus, G. taihorinensis, G. tuberculatus, G. inornatus, G. taiwanellus, G. sauteri, Mesostenus taiwanus, M. suisharionis, Stenaraeoides ampingensis, Listrognatus sauteri, Hemiteles koshunensis, H. taiwanellus, Orientohemiteles ovatus, Odontocryptus brillantus, Acanthocryptus hokutensis, Leptocryptus pilosus, L. suishariensis, Girandia ranrunensis, Microcryptus magnispiracularis, Torbda sauteri, T. taihokensis, T. unicolor, Pseudotorbda geniculata, Cremastus minimus, Pristomerus punctatus, P. scutellaris, Zacharops striatus, Charops taiwanus, Dichelobosmina tuberculata, Scenocharops longipetiolaris. Campoplegidea melanocerus, C. erythra, C. sauteri, Diocles nigriabdominalis, Casinaria insularis, C. longiabdominalis, Limnerium sauteri, Anilastus formosanus, A. taihorinensis, Holocremnus geniculatus, Triclistus parallelus, T. taiwanensis,*

Exochus radialis, E. suishanus, Orthocentrus carinatus, Perilissoides cubitalis, P. formosensis, Mesoleptus sauteri, M. taihorinensis, Thymaris taiwanensis, Monoblastus nigrifacies, Kobunus filicornis. Neue Formen: *Protichneumon yayeyamensis* Matsumura f. *kankauensis, Egurichneumon agitatus* Matsumura et Uchida f. *formosanus, Goryphus taiwanellus* Uchida f. *rufithorax, Torbda taihokensis* Uchida f. *kosemponis.* S. Kuwayama.

61. **Die Mordelliden Japans (Col.) (Vierter Nachtrag.)** Hiromichi KÔNO. [Trans. Sapporo Nat. Hist. Soc., **13**, Pt. 1 (1933), 29-31.] — Notizen über 8 Arten. *Mordellistena hirayamai* und *Anaspis (Nassipa) karafutona* sind neu. S. Kuwayama.

62. **Sauter's Formosa-Collection: Subfamily Ichneumoninae (Pimplinae of Ashmead).** R. A. CUSHMAN. [Ins. Mats., **8**, No. 1 (1933), 1-50.] — 47 species of the subfamily Ichneumoninae, excepting the genus *Xanthopimpla*, are dealt with. New species: *Eugalta formosana, E. cameroni, Xorides immaculatus, X. centromaculatus, Spiloxorides rufipleuralis, S. propodeum, Siphimedia rufa, S. nigra, S. varicolor, Leptobatopsis niger, L. bicolor, Telentaea gracilis, Apophua formosana, A. gracilis, Glypta orientalis, Phytodiaetus pallidus, Polysphincta taiwanensis, Polemophthorus orientalis, Epirhyssa minuta, E. carinata, E. longibasis, E. rufescens, E. transversa, E. diversa, Exeristes sauteri, E. gracilis, Philopsyche sauteri, Choritopimpla uchidai, C. nigrescens, Zaglyptus formosus, Ephialtes leucogonia, Theronia formosana,* and *T. brevicauda.*
S. Kuwayama.

63. **Beiträge zur Systematik der Tribus Mesochorini Japans (Hym. Ichneumonidae).** Toichi UCHIDA. [Ins. Mats., **8**, No. 2 (1933), 51-63, 1 Fig.] Beschreibungen und Bestimmungstabellen der in Japan vorkommenden Gattungen und Arten. Neue Arten: *Astiphromma galloisi, A. unicolor, A. kiotense, A. sachalinense, A. punctatum, Mesochorus igarashii,* und *M. tattakensis.* S. Kuwayama.

64. **Mayflies from Japanese Torrents. III. Third Notes on the Genus *Ameletus* with a List of the Japanese Siphlonuridae.** Kinji IMANISHI. [Ins. Mats., **8**, No. 2 (1933), 64-69, 4 figs.] — Descriptions of the nymphs of *Ameletus kyotoensis* and *A. costalis* and list of 15 species, under 6 genera, of Siphlonuridae so far known in Japan. S. Kuwayama.

65. **A List of the Longicorn-beetle from Saghalien, with the Descriptions of One New Species, One New Variety and One New Aberrant Form.** Koichi TAMANUKI. [Ins. Mats., **8**, No. 2 (1933), 69-88, 1 fig.] An enumeration of 86 species of Cerambycidae from Saghalien, 59 already known and 27 newly added. New species: *Grammoptera cyanea.* New variety: *Allosterna elegantula* Kraatz var. *debilis.* New form: *Leptura variicornis* Dalman ab. *nigromarginata.* S. Kuwayama.

66. **A List of Cymatophoridae in Japan, Korea and Formosa with a Generic Key.** Shonen MATSUMURA. [Ins. Mats., **8**, No. 2 (1933), 89-103, 2 figs.] — A list of 57 species under 28 genera, with description of *Sugitaniella kurayana* gen. et sp. nov.
S. Kuwayama.

67. **On Brachiopods from Mutsu Bay.** (Japanese.) Ichiro HAYASAKA. [Venus, **3**, No. 1 (1931), 1-9.] — Description of *Lingula* sp. nov., *Hemithyris psittacea* (Gmelin) var. *woodwardi* (Adams), *Terebratulina* indet. sp., *Terebratalia coreanica* (Adams & Reeve), *Coptothyris grayi* (Davidson) subsp. nov., *Laqueus rubellus* (Sowerby). T. Uchida.

68. **On Molluscs of the Islands Ôshima and Kojima, Tango.** (Japanese.) Nobusane TAN. [Venus, **3**, No. 1 (1931), 9-21.] — Notes on and list of terrestrial and marine mollusks from the islands. T. Uchida.

69 **Fresh-water and Land Mollusks from Tobijima Island.** (Japanese.) Shigeo EMURA. [Venus, **3**, No. 1 (1931), 22-25.]

70. **Miscellaneous Notes on Mollusks (3-5).** (Japanese.) Iwao TAKI. [Venus, **3**,

No. 1 (1931), 42-45; No. 4 (1932), 206-216; No. 6 (1933), 346-358.]

71. Two New Species of Volutacea Tokubei KURODA. [Venus, **3**, No. 1 (1931), 45-49.] — Descriptions of *Teramachia tibiaeformis* n. g. et n. sp. and *Phenacoptygma* (?) *kiiense* n. sp., both from the coasts of Prov. Kii. The shell of the former genus resembles that of *Tibia* (=*Rostellaria*) but recalls that of *Lyria* in the possession of an operculum with a subspiral blunt apex, and is characterized by the absence of "fingers" and sinus on the lower part of the outer lip. T. Uchida.

72. Three New Forms of *Euhadra*. Tokubei KURODA. [Venus, **3**, No. 1 (1931), 49-53.] — Descriptions of *Euhadra grata emurai* n. subsp. (loc. Katsuki, northern Echigo), *E. grata tobisimae* n. subsp. (loc. Tobishima, Ugo) and *E. senckenbergiana daisenica* n. subsp. (loc. Daisen and Ôtani, Takeda-mura). T. Uchida.

73. On the Life-history of *Bradybaena similaris stimpsoni* (Pfeiffer). Shigeo EMURA. [Venus, **3**, No. 2 (1932), 72-91; No. 3 (1932), 133-140.] — Notes on copulation, egg laying, hatching and growth, with descriptions of the genital apparatus. Copulation takes place from spring to autumn in a similar manner as in Helicidae, but keeping the penis mostly outside the body. The spermatheca is long ellipsoidal and resembles that of *Philomycus bilineatus*, but is distinguished from that of *Euhadra*. After copulation the dart would be detatched from the sac and sent into the receptaculum seminis with its blunt end ahead. Except during hibernation the snail is able to lay eggs all the year round after one or several copulations. During egg laying the antenna is not stretched out. The average number of eggs laid by an individual is 190 in 11 egg layings, and there were 1-92, but mostly 1-20, in one laying. Self-fertilization occurs in snails isolated after hatching out. The shell appears in 9 days after fertilization, and hatching takes place in 21-22 days. Growth is very rapid; maturity is reached in 80-90 days; about two weeks afterwards the first copulation takes place and egg laying occurs about 6 days after. T. Uchida.

74. Additional Data on the Distribution of *Margaritifera margaritifera* (L.). Yaichiro OKADA and Kazuo KOBA. [Venus, **3**, No. 2 (1932), 106-108.]

75. Land Molluscan Fauna of Kôtôsho, Taiwan. Tokubei KURODA. [Venus, **3**, No. 4 (1932), 187-192, 1 pl.] — A list of 2 species of Operculata, 13 of Plumonata and 2 freshwater, with descriptions of *Helicostyla* (*Opalliostyla*) *okadai*, *Euhadra kanoi*, *Coniglobus* (?) *batanica botellobagaensis*, *Zaptyx* (*Heterozaptyx*) *takahashii*, *Zaptyx* (*Heterozaptyx*) *kotoshoensis*. T. Uchida.

76. On Egg Laying of Isolated *Lymnaea*. (Japanese.) Shuhei SONEZAKI. [Venus, **3**, No. 4 (1932), 192-202.] — Observations on *Lymnaea* (*Radix*) *japonica* Jay and *L.* (*Galba*) *pervia* Martens from the neighborhood of Hiroshima. Growth is more rapid in isolated individuals than when kept together, but there is no noticeable difference in the number and growth of eggs laid. T. Uchida.

77. The Home of *Semisulcospira libertina nassaeformis* Kuroda et Kanamaru. (Japanese.) Masuzo UENO. [Venus, **3**, No. 4 (1932), 203-205.] — Chemical conditions of the water of Akiyoshi-do, Yamaguchi Pref., the only locality where this gastropod is known to occur. T. Uchida.

78. On Mollusks from the Vicinity of Takao, Formosa. (Japanese.) Aoshi YAMAGUCHI and Naokichi MIYAGI. [Venus, **3**, No. 4 (1932), 224-228.]

79. A List of Cephalopods from Kagoshima Bay. Shintaro UTSUNO. [Venus, **3**, No. 4 (1932), 228-233.]

80. On the Occurrence of *Pictothyris* in the So-called Riukiu Limestone of Takao, Taiwan (Formosa). Ichiro HAYASAKA. [Venus, **3**, No. 5 (1932), 249-251.] — *Pictothyris picta* from Takao. T. Uchida.

81. List of Benthic Mollusks on the Coast of Kii Prov. (Japanese.) Toraichiro KINOSHITA. [Venus, **3,** No. 5 (1932), 251 259.]

82. On *Lithophaga curta* (Lischke). (Japanese.) Yoshimitsu TSUKAMOTO. [Venus, **3,** No. 5 (1932), 260–264.] — Notes on habitats and description of shell. T. Uchida.

83. Mollusks attached to the Marine Alga, *Gelidium Amansii*. Tazima KANAMARU. [Venus, **3,** No. 5 (1932), 271–280.] — A list of 147 species. T. Uchida.

84. Distribution and Ecology of *Valvata* in Japanese Lakes. (Japanese, with English résumé.) Denzaburo MIYADI and Syniti MORI. [Venus, **3,** No. 6 (1933), 307–316.] — Besides Asino-ko, Biwa-ko and Noziri-ko, Akan-ko and Tôro-ko (Hokkaidô), Seseki-numa, Syana-numa, Rausu-numa, Rubetu-numa, Kinmon-numa and Tosimoe-ko, in Etorohu Island (the Kurile Islands) are new localities for *Valvata*. *Valvata biwaensis* and *V. annandalei* from Biwa-ko and Noziri-ko, seem to be inseparable from *V. japonica* from Asino-ko, which also occurs in Hokkaidô and Etorohu Island. The species is closely related to the palaearctic *V. piscinalis* found in England, northern Europe and Siberia. A table of density of population of the species in Japanese lakes is given. T. Uchida.

85. Notes on the Systematic Positions of *Coniglobus* and "*Helix*" *blakeana*. (Japanese, with English résumé.) Tokubei KURODA and Iwao TAKI. [Venus, **3,** No. 6 (1933), 316–324.] — On account of conchological and malacological characters the genus *Coniglobus* should be transferred from *Euhadra* to *Ganesella*, as a subgenus of the latter, and "*Helix*" *blakeana* seems to represent a new subgenus *Ainohelix* under *Fruticicola*. T. Uchida.

86. Sex-correlated Markings in *Sepioteuthis lessoniana* Ferussac. (Japanese, with English résumé.) Hayato IKEDA. [Venus, **3,** No. 6 (1933), 324–329.] — The sex-correlated markings on the dorsal surface are due to a peculiar structure between the epithelium and muscular layer. In the male they are transverse violet streaks, but violet spots in the female. Though the number of these markings varies according to individuals, they generally range from 50 to 100, and are usually more numerous in the central part than towards the periphery. T. Uchida.

87. Notes on Molluscan Ecology (2). (Japanese.) Isao TAKI. [Venus, **3,** No. 6 (1933), 330–342.]

88. Notes on the Spiders from Formosa. Saburo SAITO. [Trans. Sapporo Nat. Hist. Soc., **13,** Pt. 1 (1933), 32–61, 1 pl.] — Description of 43 spiders, including the following 17 new species: *Bothriscyrtum tractabile*, *Ischnothele simplicata*, *Euagrus formosanus*, *Myrmarachne magnus*, *Simonella formosana*, *Smeringopus kishidai*, *Theridion elegans*, *Thericula caudata*, *Argyrodes longispinus*, *Poltys nigrinus*, *Cyclosa bicauda*, *C. spinosa*, *C. tricauda*, *Araneus lacteus*, *Gasteracantha sola*, *G. sparsa*, *G. formosana*. Tohru Uchida.

89. *Ceinina japonica* (n. gen., n. sp.), a New Aberrant Species of the Amphipodan Family Talitridae from Japan. K. STEPHENSEN. [Trans. Sapporo Nat. Hist. Soc., **13,** Pt. 2 (1933), 63–68.] — The new amphipod penetrates into the stem of the brown alga *Undaria pinnatifida*. The new genus is most closely allied to the genus *Ceina* but differs from it in having the carinate back, the deep and contiguous side plates, 1 2 distinctly subchelate pereiopods (in female), 2 pereiopods with gills and brood plates (in male). Tohru Uchida.

90. A New Genus and Some New Species of Crabs from Simoda. T. SAKAI. [Sci. Rep. Tokyo Bunr. Daig., Sec. B, **1** (1933), No. 12, 137–144, 1 pl.] — Descriptions of a new genus, *Schizophroida*, newly separated from *Schizophrys*, and four new species, *Schizophroida simodaensis*, *Sch. manazuruana*, *Caphyra yo-okadai*, *Parapinnixa asiatica*. Tohru Uchida.

91. On the Parallelism between the Distribution of Lizards and of Anurans in

the Japanese Empire. Y. OKADA. [Sci. Rep. Tokyo Bunr. Daig., Sec. B, 1 (1933), No. 13, 145–153, 1 chart.] — 1) There is a parallelism between amphibian and saurian distribution in Japan. 2) The Blakiston line is not so important for saurian distribution as for anuran, but Soya Strait seems to be more important. 3) The faunistic difference between Amami-Ôshima and Japan proper is more distinct for lizards than for anurans, showing the significance of the Watasé line. 4) The saurian fauna of Kôtôsho is related to that of the southern part of Formosa, rather than to that of the Philippines. Tohru Uchida.

92. **Some Observations of Japanese Crayfishes.** Y. OKADA. [Sci. Rep. Tokyo Bunr. Daig., Sec. B, 1 (1933), No. 14, 155–158, 1 pl.] — Notes on one Japanese and two Korean species of crayfish, *Cambaroides japonicus*, *C. similis*, *C. dauricus*. The first occurs in Hokkaidô and the northern part of Honshû, the latter two in several parts of Korea. Tohru Uchida.

93. **The Herpetological Fauna in the Vicinity of Nikkô, Japan.** Y. OKADA, [Sci. Rep. Tokyo Bunr. Daig., Sec. B, 1 (1933), No. 15, 159–173.] — Some ecological notes on the Amphibia and Reptilia occurring around Nikkô. Tohru Uchida.

94. **Über einige neue Ciliaten aus dem Darmkanal von japanischen Echinoideen (1).** M. UYEMURA. [Sci. Rep. Tokyo Bunr. Daig., Sec. B, 1 (1933), No. 14, 181–191.] — Beschreibungen von zwei neuen Ciliaten, *Entorhipidium fukuii* n. sp. und *Conchophthirus striatus* n. sp., beide aus dem Darmkanal von verschiedenen Arten von japanischen Seeigeln.
Tohru Uchida.

95. **Spiders from the Southern Kurile Islands II. Araneida from Shikotan.** M. L. PEELLE and S. SAITO. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6, Zool., 2 (1933), 109–123.] — Descriptions of *Misumena aleatoria*, *M. lutea* n. sp., *Xysticus triguttatus*, *Philodromus obsoleti* n. sp., *Tibellus oblongus*, *Clubiona perforata*, *Theridion formosum*, *Wala* sp., *Icius nigra*, *Linyphia yunohamaensis*, *Araneus thaddeus*, *Arctosa cinerea*. Tohru Uchida.

96. **Medusae from the Vicinity of Kamchatka.** Tohru UCHIDA. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6, Zool., 2 (1933), 125–133.] — Report on 10 medusae including *Sarsia inabai* n. sp., characterized by the presence of terminal swellings on the tentacles. *Halitholus pauper* hitherto known only from Greenland and Iceland is reported from the Pacific.
Author.

97. **On the Morphology of a Stalked Medusa, *Thaumatoscyphus distinctus* Kishinouye.** Tohru UCHIDA and Kin-Ichiro HANAOKA. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6., Zool., 2 (1933), 135–153.] – Detailed description of the external and microscopical anatomy with notes on the formation of nematocysts, abnormalities and habits. Authors.

98. **Testis Grafts in a Frog and their Relation to Sexuality.** Tohru UCHIDA. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6, Zool., 2 (1933), 155–178, 1 pl.] – Testicular pieces of adult *Rana temporaria* were engrafted in the lymph sac, breast muscles, eye socket, stomach wall, mesentery, and liver of normal or castrated adults of both sexes. Regeneration of the engrafted testes goes on similarly in both sexes, whether normal or castrated. The grafts regenerate well in the stomach wall and mesentery but degenerate in the eye socket and liver. Of those engrafted in the lymph sac and the breast muscles, some regenerated and some degenerated, probably owing to external influences. No ovum is found in regenerated testicular grafts. The regenerated ova reported from transplanted testes are probably derived from pre-existing ova of the graft. Author.

99. **The Polychaete Genus, *Acrocirrus*, from Japanese Waters.** Shiro OKUDA. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6, Zool., 2 (1934), 197–209.] — Descriptions of *Acrocirrus uchidai* n. sp., *A. muroranensis* n. sp. and *A. varidus*, both new species from Hokkaidô.
Tohru Uchida.

100. Anatomy of Two Stalked Medusae with Remarks on the Distribution of the Stauromedusae in Japan. Tohru UCHIDA and Kin-Ichiro HANAOKA. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6, Zool., 2 (1934), 211–239.] — Anatomy of *Haliclystus borealis* and *H. steinegeri*, newly found in Japanese waters, with note on a hexamerous specimen of the former and of young stages of the latter. With regard to their distribution Japanese stalked medusae are cosmopolitan, temperate or boreal. Authors.

101. Revision of *Stylastis* and its Allied Genera, with Description of *Stylactella* (*Stylactis*) *yerii* n. sp. Masao IWASA. [Jour. Fac. Sci. Hokkaido Imp. Univ., Ser. 6, Zool., 2 (1934), 241–277.] — Of the species so far included in *Stylactis*, *Stylactella* or *Stylactaria* (Hydroida, Podocorynidae), 13 are referred to *Stylactella* sensu auct., with *Stylactis* and *Stylactella* as subgenera. Descriptions and figures of 19 species are given, with remarks on the distribution of *Stylactella* and a map. *Stylactella* (*Stylactis*) *yerii* n. sp., found growing upon a living gastropod, *Turricula* (*Surcula*) *kamakurana* Pilsbry in Sagami Bay at 60 fathoms, has gastrozooids with 10–14 filiform tentacles and blastostyles with 4 tentacles and cryptomedusoid sporosacs. No spines or nematozooids. Author.

102. On Atypical Spermatozoa in *Viviparus* and Some Other Species among the Prosobranchiates. (Japanese.) Jun-ichi MORITA. [Venus, 3, No. 2 (1932), 61–71.] — A check list of the prosobranchiates in which atypical spermatozoa have been reported, is given in the first place, and the ratio of typical to atypical spermatozoa in various species is dealt with. In *Viviparus* (4 species, 52 individuals), there are no seasonal variations and atypical spermatozoa are two to three times as numerous as typical ones. In *Strombus luhuanus* L. (summer, 8 individuals) and *Conus* (summer, 2 species), which have relatively the least number of atypical spermatozoa, the ratio typical : atypical is 100 : <1; in *Planaxis sulcatus* Born (summer, 4 individuals), *Semisulcospira libertina* (Gould) (June-February next, 22 individuals) and "*Cerithium*" *concisum humile* Dunker (summer, 9 individuals), the ratio is 100 : 10–20. The genus *Viviparus* is unique in having two types of atypical spermatozoa, micro- and macro-atypical, equally numerous all the year round. The genital apparatus of female *Viviparus* is described with reference to the fate of atypical spermatozoa in the female body; no atypical spermatozoa are found in the spermatheca. A. Ichikawa.

103. Studies on the Molluscan Fauna of Toyama Bay. 1. (Japanese, with English résumé.) Tokubei KURODA and Kanzaemon KIKUCHI. [Venus, 4, No. 1 (1933), 1–14, 1 pl., 1 map, 4 figs.] Toyama Bay is at 137°–137°35′ E. and 36°45′–37°30′ N. In the soft calcareous sandy rocks of the tidal zone of the western shore, live several tropical or subtropical boring bivalves, such as *Botula cinnamomea*, *Coralliophaga coralliophaga* and *Aspidopholas yoshimurai*, etc. The common littoral species of the southern and western coasts of Honshû, Shikoku and Kyûshû are also found from low tide mark down to several meters' depth. The influence of a branch of the warm Kuro-Siwo is felt down to the depth of 100 m. but not beyond 300 m., so that genuine boreal forms such as *Buccinum*, *Neptunea* (= *Chrysodomus*), *Plicifusus*, etc, occur at greater depths. 11 species of *Dentalium* are listed, with descriptions of 8 species, of which *D.* (*Laevidentalium*) *toyamaense*, *D.* (*Episiphon*) *makiyamai*, *D.* (*Dentalium*) *nivosum*, and *D.* (*Dentalium*) *habutae* are new. A. Ichikawa.

104. A New Species of Fossil *Ringicula* from the Japanese Miocene. Yanosuke OTUKA. [Venus, 4, No. 1 (1933), 15–16, 4 figs.] — Description of *Ringicula* (*Ringiculina*) *minohensis*. A. Ichikawa.

105. On the Copulatory Organ of *Ganesella japonica* (Pfeiffer), with Special Reference to the Function of the Appendix. (On the Functional Morphology of the Reproductive Organs of the Japanese Pulmonata. I.) (Japanese.) Shigeo EMURA. [Venus, 4, No. 1 (1933), 17–24, 1 pl., 6 figs.] — The first part is concerned with gross anatomy and histology. The second section deals with the manner of copulation. The function of the appendix, morphology of the spermatophore and the mechanism of its transfer from one copulating animal to the other are fully described. The calciferous glands of the flagellum, of the main part of the penis and of the appendix are reproduced photographically. A. Ichikawa.

106. On the Occurrence of *Bulimus* (*Bulimus*) *ussuriensis* (Ehrmann) in Hokkaidô, with a Note on its Distribution. (Japanese, with English résumé.) Syuiti MORI. [Venus, **4,** No. 1 (1933), 25–31, 6 figs.] — First record of the subgenus *Bulimus* from Japan. Tôro-ko, a lake about 22 km north of the city of Kusiro, is the only locality in Japan where this species occurs. Discussion of the significance of this discovery from the distributional viewpoint.
A. Ichikawa.

107. X-ray Photomicrograph of very Small Shells. (Japanese.) Kogorô KAWAJI. [Venus, **4,** No. 1 (1933), 31–36, 13 figs.] — X-ray photographs of very small shells like *Diplommatina* (*Sinica*) *tosana kureana* Pilsbry et Hirase, *Alvania tokyoensis* (Pilsbry), *Gyraulus compressus japonicus* (Martens), *Hirasea acuta* Pilsbry, *Carychium hachijoense* Pilsbry, etc., by means of the Shearer tube.
A. Ichikawa.

108. Miscellaneous Notes on Mollusks (6). (Japanese.) Iwao TAKI. [Venus, **4,** No. 1 (1933), 38–43.]

109. Generic Names of Japanese Mollusks (2). (Japanese.) Tokubei KURODA. [Venus, **4,** No. 1 (1933), 44–54.]

110. The Late Professor Tomotarô Iwakawa (1854–1933). (Japanese.) Isawo TAKI and others. [Venus, **4,** No. 2 (1933), 63–86, portrait.] — Biography and appreciation, with a list of his publications.
A. Ichikawa.

111. Observations on *Crepidula* (*Syphopatella*) *walshi* (Hermannson) Reeve and *Crepidula* (*Ianacus*) *unguiformis* Lamarck. (Japanese.) Isawo TAKI. [Venus, **4,** No. 2 (1933), 87–100, 1 pl., 9 figs.] — Anatomical and histological notes on *Crepidula* (*Syphopatella*) *walshi* and *C.* (*Ianacus*) *unguiformis*.
A. Ichikawa.

112. Distribution of Japanese *Turbo* Shells. (Japanese.) Yaichirô OKADA and Tadashi FUJITA [Venus, **4,** No. 2 (1933), 101–113, 1 map, 9 figs.] — An annotated list of 19 species and 3 subspecies of Japanese *Turbo*, with discussion of its distribution in Japan.
A Ickikawa.

113. Ecological Distribution of the Genus *Semisulcospira* in the Environs of Kyôto. (Japanese.) Gorô FUKUOKA. [Venus, **4,** No 2 (1933), 114–118, 7 figs.] – 4 species and 3 varieties are listed with localities and ecological notes.
A. Ichikawa.

114. Stories of the Land Snails. (Japanese.) Iwao TAKI. [Venus, **4,** No 2 (1933), 118–141.]

115. Notes on *Nuculana gordonis* (Yokoyama). (Japanese.) Yanosuke OTUKA. [Venus, **4,** No. 2 (1933), 142–143, 1 fig.]

116. The Soft Body of *Spirula*. (Japanese.) Yaichirô OKADA. [Venus, **4,** No. 2 (1933), 144–145, 1 fig.] — A specimen found in a tunny caught at 5°55′ N., 95°39′ E., north coast of Sumatra.
A. Ichikawa.

117. Studies on the Polyhedral Disease of the Silkworm. Parts III–IV. (Japanese.) Etsuo KITAJIMA [Kagoshima Kot. Norin. Gak. Hok., 10. (1932), 133–190.] — Infection can be effected by injection either of the filtrate or filtrated polyhedra of the body fluid of diseased worms, while passage through Reichert and Berkefeldt's filtration tube destroys all ability to produce symptoms of the disease. Hence the author concludes that the germ exists in the body fluid without the polyhedra. The germ is killed by immersion in water of 100°C for 3 minutes, of 70°C for 30 minutes, and of 60°C for 1 hour. On infection with heated germ the symptoms come out 1–4 days later, and a goodly number of the treated worms continue normal life. The germ is very resistent to dry heat and cannot be killed by exposure to 100°C for 3 hours. The

polyhedra dissolve in the gastric fluid but the germ is still infective for 2–4 hours; in 6-24 hours however it becomes inactive. Alkaline solution with pH near that of the gastric fluid dissolves the polyhedral crystals without killing the germ, unless the pH is higher than 11.468.
N. Yagi.

118. **On a New Hunting Wasp from Japan.** Keizo YASUMATSU and Hisashi MASUDA. (Japanese, with English résumé.) [Fukuoka Hakub. Z., 1, No. 1 (1932), 53-65, 1 pl.] — The new species described with some observations on the morphology of the larva and the behavior of the wasp, is *Alyson cameroni* Yasumatsu et Masuda. N. Yagi.

119. **Reports of Scientific Survey of Okinoshima (I). III. Insect Fauna of the Island.** (Japanese.) Hiroshi HORI. [Fukuoka Hakub. Z., 1, No 2 (1933), 170-176.] — Okinoshima is a small rocky island in the Genkai Sea. 96 insect species referable to 45 families belonging to Diptera, Hymenoptera, Coleoptera, Lepidoptera, Neuroptera, Hemiptera, Odonata, Dermaptera and Orthoptera, are listed. N. Yagi.

120. **On the Ascending Flight of *Parnara guttata* Bremer et Grey.** (Japanese.) Nansaburo OMORI. [Kontyu, 7, No. 2 (1933), 55 64.] — The adult of *Parnara guttata* flies almost vertically upward as high as 36 meters or more, when the antennae are removed or damaged mechanically or chemically. Narcosis of the whole body or of the antennae had the same effect. There must be some center in the antennae for controlling normal flight, the removal or stupefying of which causes abnormal upward flight. N. Yagi.

121. **Bionomics and External Structures of *Liparis dispar*, an Insect Noxious to *Livistonia chinensis*.** (Japanese, with English résumé.) Shigeru NAKAZIMA and Kiyoharu FURUKAWA. [Bull. Miyazaki Coll. Agr. For., No. 5 (1933), 1-12, 3 pls.] — Although the larva of *Liparis dispar* is known to be noxious to various plants, *Livistonia chinensis* has never been known to be its food plant. This is a subtropical palm growing on the small island, Aoshima, on the southern coast of Kyûshû. The larva hatches from the hibernated egg in April and pupates at the end of May. The adult appears in the middle of June and lays eggs on the underside of *Livistonia* leaves, and overwinters. The external structures of the larva, pupa and adult are not much different from those already described. A. Yagi.

122. **On the Life History of *Tipula aino* Alexander (Tipulidae, Diptera),** I. Report. (Japanese.) Jujiro MASAKI. [Agr. Hort., 8 (1933), 1441–1450, 1649-1656, 1657-1665, 12 text figs.] — Life history of this dipteron injurious to rice plant. N. Yagi.

123. **On a New Variety of *Psithyrus sylvestris* (Lepeletier) from Corea.** (Japanese, with English résumé.) Keizo YASUMATSU. [The Insect World, 37, No. 425 (1933), 5-7.]
N. Yagi.

124. **Control of Injurious Insect by Cyloam. (Fumigation Method and Example.)** Torahiko AOYAMA. [Milit Sci. Lab. Rep. (1933), 1-36, 9 photographs.] — Cyloam is a powder which on application produces cyanogas, and can be conveniently substituted for the old method of cyanogas fumigation for the control of insect pests. N. Yagi.

125. **Elateridae in the Collection of the Entomological Laboratory, Kyushu Imperial University.** Yushiro MIWA. [Mushi, 6, No. 1 (1933), 25-31; No. 2, 66-73.] — Examination of elaterid specimens from all parts of Japan has brought out 64 species from Kyûshû, 48 species from Honshû, 9 species from Hokkaidô, 9 species from Karafuto and 13 species from Tsushima island. A new species, *Agriotes yasumatsui* Miwa, is described from Kyûshû. N. Yagi.

126. **On the Japanese and Formosan Homonotinae (Hym. Psammocharidae).** Keizo YASUMATSU. [Mushi. 6, No. 1 (1933), 39-46.] — Of the 8 genera of Homonotinae of the world, only two occur in Japan. *Homonotus japonicus* and *H. formosanus*, both new, are described. N. Yagi.

127. Some Aphididae from Tsushima. Ryoichi TAKAHASHI. [Mushi, **6**, No. 2 (1933), 51-52.] — Seven species of aphids have been found in a collection from Tsushima, as follows: *Macrosiphum gobonis* Matsumura, *Aphis oclinae* van der Goot, *Aphis nerii* Boyer, *Aphis kurosawae* Takahashi, *Chaitophorus chinensis* Takahashi, *Cinara quercihabitans* Takahashi and *Anuraphis* sp.
N. Yagi.

128. Notes on Two Hymenopterous Parasites of *Thrips* in Japan. Tei ISHII. [Kontyu, **7**, No. 1 (1933), 13-16.] — Two species of *Thrips* parasites are described from 3 host species. *Thripoctenus brui* Vuillet occurs on *Thrips tabaci L.* and *Taeniothrips* sp.; *Thripoctenus bicoloratus* Ishii was bred from the parasites of a *Thrips* on the leaves of *Piper futokazura*.
N. Yagi.

129. Studies on the Life History and Controlling Method of *Phyllobius incomptus* Sharp. (Japanese.) Masatoshi YAGO [Shizuokakenritsu Nôjishikenjô Rinji Hôkoku, No. 26 (1933), 1-12, 2 pls.]

130. A Study on the Parasite Control of Injurious Insects. (Japanese.) Izumi HAYASHI. [Trans. Tottori Soc. Agr. Sci., **4**, No. 3 (1930), 229-243.] Parasite control of insects suffers from many restraining factors. The author looks upon the following conditions as the main controlling factors. 1) Time and space relation between host and parasite; 2) morphological effects of parasite on host; 3) physiological affinity between the host and parasite; 4) modification of parasitisms, like polyparasitism and hyperparasitism; 6) behavior of host and parasite.
N. Yagi.

131. Experiment on the Control of the Pear Borer, *Eurhodope pirivorella* Matsumura. (Japanese.) Masatoshi YAGO. [Shizuoka-ken Agr. Exp. Sta. Bull., 27, (1933), 1-14, 5 text figs.] — The moth of this borer is phototropically active at night. Both sexes are attracted by light traps, electric and acetylene. The female comes out before and the male after midnight.
N. Yagi.

132. Biological and Morphological Studies on the Phasmidae of Japan. Keizo YASUMATSU. (Japanese.) [Mushi, **3**, No. 1 (1930), 49-59; No. 2, 74-79; **4**, No. 1 (1932), 21-42, 2 pls.] The female of *Phraortes stomphax* Westwood moults 6 times and the male 5 times; the former takes 3 months and the latter 2 months to complete development. Sex differences apparently come out after the fifth moult in both sexes. After maturation the female lives much longer than the male. Oviposition begins 10 days after the sixth moult, and continues to death. Average number of eggs for 6 individuals was 309 per head. The egg, with capitulum and operculum at the flat end, is very conspicuous as in this group generally. Abnormality in egg shape is brought about by 1) doubling of egg capsule, 2) division of micropyle into two, 3) absence of micropyle, 4) presence of operculum on both sides of the egg, 5) doubling of capitulum on operculum and 6) displacement of operculum. Egg stage continues from the middle of July to the end of next March, for 221-259 days. The nymph hatches at the beginning of April, first protruding the head, then the thorax, abdomen and legs. Great many nymphs die from the difficulty of pulling out the ends of the long legs. Extension of the external body parts is effected after emergence. The growth of the thorax is empirically expressed by the formula $y=2.1x$, of the abdomen by $y=1.2x$, of the segment of the legs by $y=1.4x$ and of the antenna by $y=1.3x$.
N. Yagi.

133. On the Normal Position of the Male Reproductive Opening in the Earthworm, *Pheretima hilgendorfi* Michaelsen, and its Variation in Number and Position. (Japanese.) Hideji YAMAGUCHI. [Dob. Z., **43**, No. 511 (1931), 393-399, 2 figs.] — Of 1005 full-grown specimens examined, 117 had reproductive openings whose number and position were as follows. 1) one pore on XVI. segment (right or left); 2) one on XVII (r. or l.); 3) one on XVIII (r. or l.); 4) two on XVII (bilateral); 8) two on XVIII (bilateral); 6) two on XVII (l.) and XVIII (r.); 7) two on XVII (r.) and XVIII (l.); 8) two on XVI (l.) and XVII (r.); 9) two on XVI (r.) and XVII (l.); 10) two on XVII (r.) and XVIII (r.); 11) three on XVI (l.) and XVII (bilateral); 12) three on XVII (bilateral) and XVIII (r.); 13) three on XVII (r. or

l.) and XVIII (bilateral); 14) three on XVI (r.), XVII (r.) and XVIII (r.). T. Goda.

134. Ledridae in Japan. (Japanese with English note.) Masayo KATO. [Dob. Z., **43**, No. 512 (1931), 431-440, 10 figs.] Descriptions of 23 forms, referable to 8 genera, of which 4 genera, *Petalocephaloides, Funkikonia, Parapetalocephala, Midoria* and 9 species, *M. capitata, Tituria obtusa, T. rubromarginata, T. castanea, T. taikosana, Parapetalocephala montana, Petalocephaloides laticapitata, Ledropsis wakabae* and *L. takasagona* are new. T. Goda.

135. Some Experiments on the Association Formation of a Fox Terrier. (Japanese.) Yoshiaki ONO. [Dob. Z., **43**, No. 513 (1931, 473-483.] — At about 2 m. in front of a fox terrier about one year old, pieces of differently dyed cloths were placed in a row, and an association was formed by rewarding the dog by giving him something to eat when blue cloth called by the trainer was brought to him. In the row of black, purple, blue, brown, green, red, yellow, light blue, light red and white, blue was often confused with purple. The quantitative discrimination of color is more important than the qualitative. T. Goda.

136. Some New Birds in Palao and Mariana Islands. (Japanese with English note.) Nobusuke TAKATSUKASA and Yoshimaro YAMASHINA. [Dob. Z., **43**, No. 513 (1931), 484-487.] — *Halcyon chloris orii* from Rota, *Conopoderas yamashinae* from Pagan, *Monarcharses taka-tsukasae* from Tinian, *Zosterops semperi rotensis* from Rota and *Aplorinis opaca aenea* from North Mariana; diagnoses, dimensions and remarks in English. T. Goda.

137. On the Differentiation of Germ Layers in the Common Japanese Oyster, *Ostrea gigas*. (Japanese.) Tsunenobu FUJITA. [Dob. Z., **43**, No. 513 (1931), 488-496, 7 figs.] — Observations on artificially fertilized eggs. A ripe spermatozoon can fertilize an egg which is not thoroughly ripe, but the converse does not hold. After fifteen minutes the first polar body begins to appear. From this time on up to the formation of the blastomeres A, B, C and D, cleavage goes on in the same way as in *O. virginica*, the trefoil stage being followed by the two-cell stage with the disappearance of the polar lobe, and the four blastomeres are disposed in spiral symmetry. The subsequent cleavage proceeds in laeotropic order from blastomere B, and 4 micro- and 4 macromeres are produced. The first ectomere appears at the eight-cell stage, the first somatoblast at the nine-cell stage, the first trochoblast at the sixteen-cell stage, the first endomere and mesendomere at the twenty-nine-cell stage. The three germ layers differentiate distinctly at the thirty-cell stage, four hours after fertilization, when the embryo consists of four first ectoderm cells, twelve trochoblasts, three second ectoderm cells, four third ectoderm cells, two somatoblasts, four endoderm cells and one urmesomere. T. Goda.

138. On the Diminution in Weight of Visceral Organs in the Pigeon during Hunger. (Japanese.) Genkiti NISIMURA. [Dob. Z., **43**, No. 514 (1931), 511-516.] In starvation to death the diminution in weight of the visceral organs of pigeons was as follows in both sexes: pancreas 60-70%, muscle 50-60%, liver and intestine 40-60%, skin and heart 40%, lung and stomach 30-40%, bone 10-19%, brain 4%. Giving water during starvation made no difference, neither was there any difference between the sexes in the length of time elapsed before death. T. Goda.

139. On the Growth Relation in *Thiala liberata*. (Japanese.) Toshio OHUE. [Dob. Z., **43**, No. 515 (1931), 551-558, 2 figs.] — The growth relation of *Thiala liberata* is expressed by the formula, length $= k \cdot width^x$. The constants, k and x, for animals less than 6 mm long are different from those for longer ones. According to E. Nomura, k is the local constant and x the specific one, while in this snail both x and k vary with locality. Clearer water gives larger x, and vice versa for k. The wear of the shell is continuous and slow. T. Goda.

140. Quantitative Investigation of the Plankton in Aomori Bay. (Japanese.) Seiji KOKUBO and Tadasi TAMURA. [Dob Z., **43**, No. 515 (1931), 558-585, 12 figs.] — See Abstract 416, p. (89), Vol. IV, No. 4, of this journal.

141. Fulgoridae in Japan. (Japanese.) Masayo KATO. [Dob. Z., **43,** No. 516 (1931), 595-598.] — A list of 9 forms, referable to 5 genera. T. Goda.

142. On Two New Birds from the Caroline Islands. (English.) Nobusuke TAKA-TSUKASA and Yoshimaro YAMASHINA. [Dob. Z., **43,** No. 516 (1931), 599-600.] — Descriptions of *Cinnyrorhyncha longirostra* and *Munia* (*Donacola*) *hunsteini minor* from Ponape. T. Goda.

143. The Chromosomes of *Diestrammena japonica* Karny. (An Orthopteran.) (Japanese with English résumé.) Sajiro MAKINO. [Dob. Z., **43,** No. 517 (1931), 635-646, 5 figs., 1 pl.] — In the spermatogonial metaphase there are 56 telomitic rod-shaped autosomes and 1 atelomitic V-shaped sex chromosome. In the primary spermatocyte metaphase there are 28 autosome tetrads and 1 V-shaped sex chromosome without linkage between them. There are two kinds of secondary spermatocytes, one with X-element and 28 chromosomes and the other with 28 chromosomes only. The second division is equational for the sex chromosome.
T. Goda.

144. New Scale Insects and White Fly found during Plant Quarantine. (Japanese with English résumé.) Inokichi KUWANA and Kyohei MURAMATSU. [Dob. Z., **43,** No. 517 (1931), 649-660, 6 pls.] — Descriptions of *Chiomaspis cacti, C. miyakoensis, C. javanensis, Phenacaspis dendrobii, Lepidosaphes cycadicola, Aspidiotus australiensis, Asp. biprominens, Asp. javanensis, Eriococcus shiraiwai, E. kaki* and *Aleurocanthus palauensis.* T. Goda.

145. Trial and Error Experiments on the Japanese Freshwater Fish *Oryzias latipes.* (Japanese.) Yoshiaki ONO. [Dob. Z., **43,** No. 518 (1931), 675-687, 1 fig.] — The investigation was performed in a labyrinthine aquarium. In the first experiment fishes were fed at a certain point of the labyrinth and then put back to the starting point; if the fishes succeed in reaching the food again, the trial is correct. In the second experiment fishes were fed and put back to the starting point as in the first, and the points which they pass within ten minutes thereafter noted. The coefficient of "trial and error" and of "trial and correct" are calculated from the data obtained. T. Goda.

146. Observation on *Mayorella* (=*Amoeba*) *dofleini.* (Japanese.) Hideji YAMAGUCHI. [Dob. Z., **43,** No. 518 (1931), 688-696, 5 figs.] — An amoeba found in paramecium culture is identified as *Mayorella dofleini*. It has bluntly pointed, conical "determinate pseudopods" and moves in sinuous path. When suspended in the medium it assumes a rayed or radiosa form.
T. Goda.

147. Supplement to Freshwater Cyclopidae of Formosa. (Japanese.) Isokiti HARADA. [Dob. Z., **44,** No. 521 (1932), 94-99, 17 figs.] — Descriptions of six new species and two new subspecies: *Eucyclops (Tropocyclops) parasinus candidiusi, E. (Tropocyclops) nigroviridis, E. polyacanthus, Cyclops (Megacyclops) formosanus, C. (Diacyclops) crassicaudis taipehensis, C. (Microcyclops) kentanensis, Mesocyclops (Thermocyclops) brevifurcatus* and *M. (Thermocyclops) ianthinus.*
T. Goda.

148. Biometric Studies on Some Univalves. (Japanese.) Masao TAKANO. [Dob. Z., **44,** No. 521 (1932), 100-108, 7 figs.] — The species studied were *Nassarius hispidus, Umbonium giganteum, Pythia striata, Monodonta labis* and *Nerita plicata*. The height-width growth curve has a turning point where the observed and mean values coincide; and it is related to the attainment of maturity. The spiral is expressed by a logarithmic curve and is of two kinds shown by the equations $r=ae^{m\varphi}$ and $r=ae^{m\varphi^n}$, where r is the height of each whorl and a, *m*, and *n* are constants. To the first kind belong *Umbonium, Terebra, Trochus* and *Tegula*; to the latter *Haliotis, Conus* and *Polinices.* T. Goda.

149. On a Cestode found in *Plecoglossus altivelis.* (Japanese.) Naokata KATAOKA and Kenji MOMMA. [Dob. Z., **44,** No. 522 (1932), 127-136, 2 figs., 1 pl.] — A cestode from *Plecoglossus altivelis* is identified as *Proteocephalus neglectus.* T. Goda.

150. On the Effect of Various Acids on the Digestion of Proteins by Pepsin. (Japanese.) Kunio OKAHARA. [Dob. Z., **44**, No. 522 (1932), 137-144, 2 figs.] — The proteins employed were serum and edestine, and the added acids hydrochloric, formic, acetic, propionic, butyric, oxalic, maleic, malonic, malic, tartaric and citric. The optimum acidity for peptolysis by edestine differs with each acid, and is parallel to the dissociation constant of the acid; it also differs for different conbinations of proteins and acids. The dissociation constant of pepsin-protein depends upon the acid employed in the experiment. T. Goda.

151. New Copepods from the Southern Waters of Japan. (Japanese with English résumé.) Takamochi MORI. [Dob. Z., **44**, No. 523 (1932), 167-177, 2 figs., 5 pls.] - Descriptions of 10 new forms of Pacific copepods collected from off the eastern coast of Formosa, the Formosan Strait and the East China Sea. *Scaphocalanus pacificus*, *Centropages longicornis*, *Candacia bicornuta*, *C. curva*, *Pontellopsis aequalis*, *Pachysoma dentatum* and *Copilia longistylis* are new species. The males of *Paracalanus aculeatus*, *Pareuchaeta flava* and *Labidocera pavo* are new. T. Goda.

152. Ein Beitrag zur Kenntnis der Hb-Kristalle von Schildkröten. (Japanisch mit deutsch. Resume.) Sunao OGISU und Hisahiko KUSUNOKI. [Dob. Z., **44**, No. 523 (1932), 179-187, 2 figs., 1 pl.] — Das Haemoglobin von *Clemmys japonica* und *Geoclemmys reevesii* kristallisiert sich in triklinischen Prismen mit gleichartigen Flächen; das von *Amyda japonica* sowohl in rhombischen Prismen als auch langen, höchst wahrscheinlich monoklinischen Nadeln. Die Hb-Kristalle leisten einen guten Dienst bei der Feststellung der Verwandtschaft von Tieren. T. Goda.

153. Über die auf Sado-Insel gesammelten Bockkäfer. (Japanisch mit deutsch. Resume.) Masaka MATSUSHITA. [Dob. Z., **44**, No. 523 (1932), 188-191.] - Eine Liste von 23 Prioninae aus Sado, und eine Beschreibung von *Strangalia santhoma* var. *sadoensis* n. var. und *S.* (s. str.) *kinhokuana* nov. sp. T. Goda.

154. The Genus *Antonina* (Family Coccidae) of Japan. (Japanese with English résumé.) Inokichi KUWANA. [Dob. Z., **44**, No. 524 (1932), 213-220, 2 figs.] — Descriptions of three species of *Antonina*, *A. indica* from Yayeyama in Ryûkyû, *A. crawi* from Japan proper and Formosa, and *A. tobai* from Iwate Prefecture, Japan proper, with reference to their host plants. T. Goda.

155. Further Note on the Birds of the South Sea Islands. (Japanese.) Nobusuke TAKATSUKASA and Yoshimaro YAMASHINA. [Dob. Z., **44**, No. 524 (1932), 221-226.] — Description of a new subspecies, *Globicera oceanica ratakensis*, from the Ratak Group, Marshall Islands, differing from all other forms of *G. oceanica* by its smaller size, more bronz-sheen on the back, more vinaceous grey on the breast and duller brown on the abdomen. 77 forms of birds from the South Sea Islands are also listed. T. Goda.

156. On Nocturnal Collecting in Shisôjima. (Japanese.) Nanzaburo OMORI. [Dob. Z., **44**, No. 524 (1932), 227-233, 2 figs.] — On the night of August 29, 1931, 750 insects, referable to 5 genera and 20 species, were collected at low tide on Shisôjima, a small rocky island 800 m. off shore near the Seto Marine Biological Laboratory. 98.4% were marine or submarine forms. The oviposition of *Agromyza* sp. seems to continue for several hours, while that of *Tanytarsus* sp. takes place at about 8-10 p. m. T. Goda.

157. A Key to the Freshwater Rhabdocoelida of Japan. (Japanese.) Kazunosuke OKUGAWA. [Dob. Z., **44**, No. 525 (1932), 263-278.]

158. A Simple Method of Quantitative Measurement of Zoo- and Phytoplankton. (Japanese.) Seiji KOKUBO. [Dob. Z., **44**, No. 525 (1932), 279-289, 8 figs.] — Zooplankton can be separated from phytoplankton by filtration through Müller gauze No. 3, although some copepods like *Onchaea*, *Corycaeus* etc. often pass through it, while some phytoplankton like *Biddulphia sinensis*, *Coscinodiscus asteromphalus* and *C. Janishii* do not. The sum of the volumes of the two

kinds of plankton after filtration is smaller than before filtration, perhaps owing to the exceptionally large volume of phytoplankton. T. Goda.

159. On the Nematode *Tanqua tiara* obtained from the Lizard *Varanus salvator.* (Japanese.) Osamu ICHIKAWA. [Dob. Z., 44, No. 525 (1932), 290–294, 6 figs.] — Description of *Tanqua tiara* found in excreta of *Varanus salvator.* T. Goda.

160. Life History and Development of Color Patterns in *Siganus fuscescens.* (Japanese.) Keitaro UCHIDA [Dob. Z., 44, No. 526 (1932), 309–322, 6 figs.] - The eggs are small, hypostatic and adhesive and contain 15-16 oil globules each. Young of 14.0 mm, 18.5 mm, 22.0 mm, 23.0 mm and 29.5 mm in body length were collected. The smallest ones swim about in the offing, those of the second, third and fourth sizes live among floating seaweeds, and those of the fifth form shoals in shallow places near shore. Examples of the first mentioned size have transparent body and a very small number of scattered melanophores; those of the second are light yellowish brown with several large, round brown patterns; those of the third have several transverse brown bands; in those of the fourth size, the lateral stripes change into cloud-like patterns with white guanine spots; those of the fifth have uniformly deep yellowish brown body. Other external characters of each stage are described. T. Goda.

161. Morphological Variations in an Earthworm, *Pheretima* sp. from Taihoku. (Japanese.) Sadae TAKAHASI. [Dob. Z., 44, No. 527 (1932), 343–360, 11 figs.] — Body length proportional to segment number. In 90% of the specimens the clitellum is XIV–XV. No distinct variation in the number and position of the spermathecal and male pores. There is no distinct relation between the size of the prostate gland and the number and size of the capsulogenous gland. In 90% of the specimens the genital papillae occur in the posterior portion of the body. The first dorsal pore is at X/XI in 99%; in 2% the pore is present in the clitellum. The average number of setae on XVI is 8 and that between the genital pores 14. T. Goda.

162. Über die Chondriosomen bei *Dicyema.* (Japanisch mit deutsch. Resume.) Shunzo TAKAGI. [Dob. Z., 44, No. 527 (1932), 361–365, 1 fig.] - Bei *Dicyema* sp. aus der Niere von *Polypus vulgaris*, enthalten alle Kopfzellen körnchenförmigen Chondriosomen. Die Rumpfzellen enthalten zumeist körnerförmige, selten stäbchenförmige Chondriosomen von etwas kleinem Durchmesser als in den Kopfzellen. Die Chondriosomen der Axialzelle sind stäbchenförmig.
T. Goda.

163. Statistical Treatment of Group. (Japanese.) Isamu MOTOMURA. [Dob. Z., 44, No. 528 (1932), 379–383, 3 figs.] - The number of individuals of species inhabiting a certain area form a geometrical progression. Expressed in equation $\log y + ax = b$, where a is the constant factor, y the number of individuals, and b a constant. T. Goda.

164. Habits of *Ilyoplax formosensis.* (Japanese with English résumé.) Sadae TAKAHASI. [Dob. Z., 44, No. 529 (1932), 407–471, 12 figs.] - This crab occurs on beaches on the western side of Formosa up to 40 cm above low tide, is active only in the daytime, feeds on small green algae, plant tissues, small crustacean larvae, many kinds of protozoa etc. The burrows are vertical. The sense of sight is better developed than that of hearing. Young live separate from adults T. Goda.

165. On Ciliates Parasitic in the Digestive Tract of Japanese Sea-urchins. I. *Entodiscus borealis.* (Japanese.) Mitsuo UEMURA. [Dob. Z., 44, No. 530 (1932), 449–457, 3 figs.] — Description of *Entodiscus borealis* (Hentschel) from the digestive tracts of *Pseudocentrotus depressus*, *Strongylocentrotus pulcherrimus*, *S. intermedius* and *Glyptocidaris crenularis.*
T. Goda.

166. On the Color Markings of *Epilachna.* (Japanese.) Masumi KURISAKI. [Dob. Z., 44, No. 530 (1932), 458–466, 6 figs.] — Variation of color spots in *Epilachna niponica*, *E. 28-maculata* and *E. admirabilis*, due to segregation, fusion or degeneration. The spots are uniform

in size in the examples from Hokkaidô and Sakhalin, but of different sizes in those from Japan proper.
T. Goda.

167. On the Cirripedia collected in Sado, Miyake Island, Itrup and Hokkaido. (Japanese.) Fujio HIRO. [Dob. Z., **44**, No. 530 (1932), 667–676, 5 figs.] — Descriptions of *Mitella mitella*, *Heteralepas (Heteralepas) quadrata*, *Octomeris brunnea* and *Tetraclita purpurascens nipponensis* from Miyake Island, *Balanus cariosus* and *Chthamalus dalli* from Itrup and Hokkaidô, *C. challengeri* from Miyake Island and Hokkaidô, *Balanus* sp. from Sado, and *Tetraclita squamosa japonica* from Miyake and Sado.
T. Goda.

168. Studies on the Chrysomelidae in the Japanese Empire. Michio CHÛJÔ. III. [Sylvia, For. Inst. Taihoku Imp. Univ., **4** (1933), 19–56, 1 fig.] IV. [Trans. Nat. Hist. Soc. Formosa, **23** (1933), 304–334, 1 pl., 1 fig.] — III. List of 42 species of Criocerinae, with key to genera and species, and descriptions of the following new species: *Lema takara*, *L. paagai*, *L. nitobei*, *L. coreana*, *L. persicariae*, *Crioceris formosensis*. IV. List of 25 species of Hispinae, with key to groups and species, and descriptions of 9 new species: *Leptispa miwai*, *L. bicolor*, *Oncocephala formosana*, *Agonia tricolor*, *A. unicolor*, *A. sonani*, *Dactylispa arisana*, *D. insulicola*, *D. latipennis*.
S. Issiki.

169. Experimental Studies on the Influence of Low Temperatures upon the Development of Fruit-flies. (Japanese.) Kiyoaki KOIDZUMI. **III. On the Velocity, Favorable Temperature, and Threshold of Development of the Pupae, Eggs and Larvae of Melon-fly (*Chaetodacus cucurbitae* Coq.).** [Jour. Soc. Trop. Agr., Taihoku Imp. Univ., **5**, No. 2 (1933), 131–154, 8 figs. (Also in Taiwan Sotok. Chuo Kenk. Nogyob. Iho, No. 94, 1–23.)] **IV. A Comparison of the Cold-hardiness of *Chaetodacus cucurbitae* Coq. at Various Stages of its Life Cycle.** [Ibid., **5**, No. 3 (1933), 317–331. (Ibid., No. 97, 1–15.)] — III. Effective temperature for egg and larva is 12°–34°C, for pupa 10°–36°, both egg and larva being unable to develop below 10° or above 36°, and the pupa below 9° or above 38°. The favorable temperature for egg and larva is 14°–32°, and for pupa 16°–30°. Individual variations in the velocity of development are remarkable at low temperatures. The curve for velocity of development is a straight line at 14°–30°C. The optimum temperature for egg and larva is 32°C, for pupa 30°C. IV. Influence of the temperature 16°–+9°C on the percentage of pupation and emergence. Young pupae are least and mature pupae most resistent to cold. Larvae of the first instar are most cold-hardy and the older ones become progressively less so. Exposure to −6°C or −3° for 2 days, to 0° for 11 days, to +3° for 18 days, or to +6° for 40 days prevents complete development in summer.
S. Issiki.

170. Bemerkungen über Coccinelliden von Formosa. R. KORSCHEFSKY. [Trans Nat. Hist. Soc. Formosa, **23**, Nos. 128 & 129 (1933), 299–304, 17 figs.] — Remarks on the synonymy, distribution and variation of color patterns.
S Issiki.

171. On *Dendrolimus punctatus* Walker, and its Parasitic Fly *Sturmia sericariae* Cornalla. (Japanese.) Takeo MITONO. [Sylvia, For. Inst., Taihoku Imp. Univ., **3** (1932), 21–38, 2 pls.] — Descriptions and brief accounts of the life history and habits of the pine moth and its tachinid parasite.
S. Issiki.

172. On Some Beetles Injurious to *Pinus luchuensis* Mayer in Formosa. (Japanese.) Takeo MITONO. [Sylvia, For. Inst., Taihoku Imp. Univ., **3** (1932), 204–210, 4 figs.] — Descriptions of *Cryptorrhynchus insidiosus* Roelofs (Curculionidae), *Monochamus tesserula* White (Cerambycidae), *Alaus putridus* Candeze (Elateridae) and *Glipa formosana* Pic (Mordellidae), with brief accounts of the habits of each.
S. Issiki.

173. On *Aprophata pachyrrhynchoides* Miwa et Mitono. (Japanese with English résumé.) Yûshirô MIWA and Takeo MITONO. [Trans. Nat. Hist. Soc. Formosa, **23**, Nos. 128 & 129 (1933), 372–375, 1 fig.] — *Doliops similis* nom. nov. is proposed for this species.
S Issiki.

174. A Systematic Catalogue of Formosan Coleoptera. Yûshirô MIWA. [Rep. Dep. Agr., Govern. Res. Inst. Formosa, No. 55 (1931), 1-359.] — List of 2336 species: Adeaphaga 165 spp., Staphylinoidea 301 spp., Clavicornia 300 spp., Serricornia 407 spp., Heteromera 256 spp., Phytophaga 319 spp., Rhynchophora 247 spp., Lamellicornia 340 spp S. Issiki.

175. A Study on the Lucanid-Coleoptera from the Japanese Empire. (Japanese.) Yûshirô MIWA. III. [Trans. Nat. Hist. Soc. Formosa, **22,** No. 120 (1932), 123-132, 2 pls.] IV. [Ibid., **23,** Nos. 128 & 129 (1933), 353-371, 3 pls.] — III. A monograph of Cladognathinae, including 8 species. IV. A monograph of Dorcinae, including 17 species. S. Issiki.

176. An Enumeration of Coleoptera from the Island Iriomote in Loochoo, with Descriptions of New Species. Yûshirô MIWA. [Trans. Nat. Hist. Soc. Formosa, **23,** No. 124 (1933), 1-15, 3 figs.] - 106 species are enumerated. New species: *Agrilus okinawensis* (Buprestidae), *Melanoxanthus pulcherus* (Elateridae), *Mordella splendens* (Mordellidae). S. Issiki.

177. Experimental Studies on the Influence of Low Temperatures upon the Development of Paddy-borer *Schoenobius incertellus* Wlk.) II. Studies on the Freezing Point of Blood in the Winter Season, as well as on the Water-content of Body. Kikuo SHIBATA. [Jour. Soc. Trop. Agr., Taihoku Imp. Univ., **5,** No. 3 (1933), 308-314, 2 figs.] — The freezing point of the body fluid is lower in January — April, as is also the water content. The freezing point is higher for pupae than for mature larvae. S. Issiki.

178. Ecology of Subterranean Insects. II. Studies on the Physical Factors affecting the Pupation Place of Subterranean Insects. Kikuo SHIBATA. [Trans. Nat. Hist. Soc. Formosa, **23,** Nos. 128 & 129 (1933), 335-351, 5 figs.] — Observations on the water content and the texture of the soil in relation to the place of pupation, as observed in melon-fly larvae S. Issiki.

179. A Systematic Study of Trypetidae in the Japanese Empire. Tokuichi SHIRAKI. [Mem. Fac. Sci. Agr., Taihoku Imp. Univ., **8** (1933), 1-509, 14 pls., 92 figs.] — Monographic descriptions of 75 genera and 165 species, with morphological accounts of the family. New genera: *Matsumuraia* (type *sapporensis* Matsumura), *Nitobeia* (*formosana* n. s.), *Pseudopelmatops* (*nigricostalis* n. s.), *Parazeugodacus* (*matsumurai* n. s.), *Paratridacus* (*yayeyamanus* Matsumura), *Proanoplomus* (*japonicus* n. s.), *Paranoplomus* (*formosanus* n. s.), *Paratrirhithrum* (*nitobei* n. s.), *Paragastrozona* (*japonica* Miyake), *Prosphenicus* (*miyakei* n. s.), *Parahypenidium* (*polyfasciatum* Miyake), *Moritsugia* (*quadrimaculata* n. s.), *Paramyiolia* (*takeuchii* n. s.), *Magnimyiolia* (*jozana* n. s.), *Tetramyiolia* (*sapporensis* n. s.), *Okuniomyia* (*bimaculicosta* n. s.), *Pseudorellia* (*nigrinotum* n. s.), *Paratephritis* (*fukaii* n. s.), *Protephritis* (*sauteri* Enderlein). New subgen.: *Spilocosmia Prospilocosmia, Acidia Pseudacidia, Noeeta Paranoeeta.* New species: *Meracanthomyia arisana, Adrama apicalis, Nitobeia formosana, Pseudopelmatops nigricostalis, Chaetodacus antennalis, C. hyalinus, C. costalis, C. tappanus, Zeugodacus arisanicus, Z. ambiguus, Z. depressus, Z. tibialis, Z. nigrifacies, Z. okunii, Parazeugodacus matsumurai, Mellesis apicalis, Proanoplomus japonicus, Paranoplomus formosanus, Paratrirhithrum nitobei, Acrotaeniostola flavoscutellata, Calosphenisca 5-maculata, Pseudospheniscus inflatus, Prospheniscus miyakei, Phagocarpus formosanus, P. connexus, P. vulgaris, Hemilea formosana, H. longistigma, Staurella oshimensis, Prospilocosmia punctata, Pseudacidia issikii, P. kuwayamai, P. takeuchii, P. yoshinoi, P. sonani, P. minowai, P. ambigua, P. lineata, P. maculata, Acidia japonica, Moritsugia quadrimaculata, Acidiella naganoensis, A. arisanica, A. mushaensis, Myiolia formosana, Trypeta trifasciata, T. luteonota, Paramyiolia takeuchii, Anastrephoides matsumurai, Magnimyiolia jozana, Diarrhegma unicolor, Rioxoptilona femorata, Tetramyiolia sapporensis, Oedaspis formosana, O. japonica, Euribia sachalinensis, E. japonica, E. formosana, Pseudorellia nigrinotum, Chaetostomella nigripunctata, Elaphromyia multisetosa, E. incompleta, Paroxyna arisana, Campiglossa longipennis, Tephritis punctata, T. inpunctata, Paratephritis fukaii, P. formosensis, Protephritis sonani, Actinoptera formosana, Trypanea ambigua, T. distincta, Icterica maculata, Paranoeeta japonica, Rhabdochaeta formosana.* New varieties: *Chaetodacus ferrugineus okinawanus, Zeugodacus synnephes dobaensis, Prospilocosmia punctata kotoshoensis, Trypanea amoena kotoshoensis.* S. Issiki.

180. Two New Plant-lice attacking the Fagageae in Formosa (Hemiptera). Ryoichi TAKAHASHI. [Jour. Soc. Trop. Agr., Taihoku Imp. Univ., **5**, No. 3 (1933), 314–316, 2 figs.] -- Descriptions of *Thoracaphis depressus* and *T. lithocarpicola*. S. Issiki.

181. Notes on the Dimorph of *Periphyllus formosanus*. Ryoichi TAKAHASHI. [Trans. Nat. Hist. Soc. Formosa, **23**, No. 124 (1933), 1–3.] — Notes and description, with key to all the species of *Periphyllus*. S. Issiki.

182. *Pemphigella aedificator* Buckton produces Gall in Formosa. Ryoichi TAKAHASHI. [Trans. Nat. Hist. Soc. Formosa, **23**, Nos. 128 & 129 (1933), 352–353, 1 fig.] -- Notes on and description of the gall. S. Issiki.

183. Observations on the Camphor Lace-bug (*Stephanitis aperta* Horvath) in Formosa. (Japanese.) Ryoichi TAKAHASHI. [Taiwan Sotok. Chuo Kenk. Nogyob. Iho, No. 93 (1933), 1–9.] — Larvae and imagoes infest the under surface of the leaves of *Cinnamomum camphora*; life of imago 22-54 days; average number of eggs laid by one female about 200; duration of egg period 14–15 days; duration of larval life 13–24 days. The habits of larvae, adult (including mating and oviposition), and controlling measures are given. S. Issiki.

184. Observations on the Coccidae of Formosa. IV. Ryoichi TAKAHASHI. [Rep. Dep. Agr., Govern. Res. Inst. Formosa, No. 63 (1934), 1–38, 24 figs.] -- List of 28 species with notes on their habits and host plants. Descriptions of 12 new species and 4 new varieties, and list of new food plants (51 species). Species of economic importance: *Eumyrmococcus smithi* Silvestri on sugar cane, *Diaspis boisduvali* Signoret on orchids, *Parlatoria mytilaspiformis* Green on tea, *P. proteus* Curtis on mango, *Poliaspis pini* Maskell on pine, *Fiorinia horii* Kuwana on rhododendron, *Pseudischnaspis anassarum* Lindinger on pine-apple, *Phenacoccus hirsutus* Green on cotton, *Pseudococcus lilacinus* Cockerell on coffee. New species: *Pseudococcus shintenensis, Aulacaspis greeni, Phenacaspis formosana, Chionaspis graminicola, Tsukushiaspis bambusifoliae, T. hichiseisana, Leucodiaspis hydrangeae, Lepidosaphes lithocarpi, Fiorinia taiwana, Neoparlatoria lithocarpi, N. lithocarpicola, Aonidia rarasana*. New varieties: *Unaspis acuminata turpiniae, Fiorinia proboscidaria randiae, F. theae turpiniae, F. taiwana arengae*. S. Issiki.

185. Aleyrodidae of Formosa. III. Ryoichi TAKAHASHI. [Rep. Dep. Agr., Govern. Res. Inst. Formosa, No. 63 (1934), 39–71, 21 figs.] — Descriptions of 24 new species and indications of 2 species new for Formosa. New species: *Dialeurodes tetrastigmae, D. rarasana, D. monticola, D. dioscoreae, D. piperis, Dialeuropora hassensanensis, Pseudaleurolobus maesae, Aleurotuberculatus latus, A. suishanus, A. lithocarpi, A. longispinus, A. melastomae, A. kuwanai, A. neolitseae, A. thysanospermi, A. lagerstroemiae, Tuberaleyrodes bobuae, Pealius polygoni, Bemisia kuwanai, Aleurolobus rhododendri, Aleurothrixus smilaceti, Setaleyrodes quercicola, Tetraleurodes oplismeni, T. graminis*. Species new for Formosa: *Aleurotuberculatus murrayae* Singh, *Aleurocanthus mangiferae* Quaint et Baker. New food plants (34 species) are enumerated.

S. Issiki.

186. Observations on a Japanese *Deuterophlebia* (Diptera.) (Japanese with English résumé.) Shi-tao YIE. [Trans. Nat. Hist. Soc. Formosa, **23**, Nos. 128 & 129 (1933), 271–296, 6 pls., 2 figs.] — Observations in its natural habitat in a creek at Kurama, North of Kyôto, throughout the season. Notes on distribution, accounts of environmental influences and habits, and detailed accounts of metamorphosis. The distribution is governed by the rate of flow, nature of water, nature of bed, and altitude. Body larger in winter than in summer; there are 5 instars. Eggs are formed early in the pupal stage, and a summer pupa has about 40 eggs, and a winter one about 100. Duration of larval life 14 days; of pupal stage 7–10 days. The larvae are found throughout the year. A living adult female was captured for the first time. S. Issiki.

187. The Influence of Temperature on the Development of Eggs and Larvae of *Ancylostoma duodenale* and *Trichostrongylus orientalis* outside the Host. (Japanese with English summary.) Toshio TURUYAMA. [Chosen Ig. Kw. Z., **23**, No. 4 (1933), 441–508.] —

Ancyl. duod. eggs are killed in one night at $-15°C$; those of *Trich. orient.* are more resistant. At 25°–33°C, eggs of both species develop rapidly and hatch mostly within 24 hours, and the larvae of *Ancyl. duod.* mature in 2–3 days, while those of *Trich. orient.* take 3–4 days. At 45°C eggs of both species are killed within a few hours. At $-17°$–$-11°C$ the larvae of *Ancyl.* are killed over night, and at 60°C within 5 seconds. At 15°C and below the majority of hookworm larvae are completely motionless; at 18°C slight motions are seen. The infective larvae of *Ancyl. duod.* are positively thermotropic; those of *Trich. orient.* are not.

N. Ishii.

188. Influence of Media upon the Development of the Ova of *Diphyllobothrium mansoni*. (Japanese with English summary.) Kikuo YAMADA. [Keio Ig., **13**, No. 2 (1933), 329–341, 1 fig.] — In dishes containing water and fecal matters, the thickness of the latter is a determining factor, a thickness of less than 0.1 cm giving good results. With water depth of 30–50 cm the development is slow and less depths give better results. pH 7.0 of the media gives the best result, development being quick and the percentage of hatching highest.

N. Ishii.

189. The Relation between Fertilization and Development of Female *Ascaris*. (Japanese.) Minoru MATSUSHIMA. [Keio Ig., **13**, No. 5 (1933), 677–690.] — Eggs are laid when the body length is 13 cm and the weight 0.4 g. Virgin *Ascaris* can be distinguished macroscopically by the absence of egg cells in the uterus, or the presence of some unfertilized egg cells in the gray, semitransparent, slender tubular uterus. The percentage of unfertilized laid eggs is related to the body length and weight of the mother worms. N. Ishii.

190. On Fertilized and Unfertilized *Ascaris* Eggs simultaneously found in the Stool. (Japanese.) Sadamu YOKOGAWA and Sei WAKESHIMA. [Nisshin Ig., **22**, No. 2 (1933), 135–143.] — Males are more resistant to anthelmintics than females. N. Ishii.

191. Experimental Studies on the Development of the Eggs and Infective Route of *Ascaris* in Nature. (Japanese.) Shigeru OCHI. [Nisshin Ig., **21**, No. 5 (1932), 733–784, 4 pls.] — *Ascaris* eggs die from lack of water, but develop well and live for 10 months in moist soil down to a depth of 91 cm. In water they develop and remain infective for 7 months. The eggs are spread by flies and continue to live after passing through their alimentary canals.

N. Ishii.

192. Production of *Ascaris* Eggs outside the Host. (Japanese.) Seika DOBASHI. [Keio Ig., **13**, No. 3 (1933), 487–506.] — *Ascaris* eggs grow better in 1% NaCl solution; temperature also has some influence, the production at 26°C being only 63.5% of that at 37°C. The average number of eggs produced per 24 hours is 218,064 fertilized eggs and 10,485 unfertilized eggs N. Ishii.

193. The Fate of Fecal *Ancylostoma* Larvae and Eggs on the Ground. (Japanese.) Kyojun KAN. [Keio Ig., **13**, No. 4 (1933), 587–592.] — Eggs and larvae on the fecal surface are less able to hatch than those in the feces. After a long time the fecal eggs disappear. Sunshine kills the fecal eggs. N. Ishii.

194. Experimental Studies on the Immunity and Treatment of *Strongyloides stercoralis* Babay. (Japanese.) Saichi SATO. **I. On Immunity.** [Fukuoka Ikw. Daig. Z., **26**, No. 9 (1933), 1526–1586, 17 figs.] **II. On Treatment.** [Ditto, 1587–1610.] — In dogs infected with *Strongyloides stercoralis* larvae the leucocytes diminish, as in immune dogs; 3 weeks after infection eosinophil cells diminish, as in immune dogs after 10 days. For 10 days after infection immune dogs discharge more larvae than non-immune dogs. In 96% alcohol, 70% alcohol, 3% raubon, 5% carbolic acid and lugol solution they die in some minutes. Lyvanol has some effect for infected dogs. Gentian violet 0.02–0.03 g per kilo is very effective, but 0.005 g per kilo is ineffective N. Ishii.

195. Experimental Studies on Ancylostomiasis Anemia. (Japanese.) Yoneji MIYAGAWA, Nobutaro ISHII and Shigeya SHIMIZU. **I. Blood Picture. II. Histological Findings.** [Jikken Ig. Z., **17**, No. 10 (1933), 1155–1172, 6 figs.] **III. *Ancylostoma caninum* Larvae Infection of Rabbits.** [Ditto, 1173–1193.] — 2–4 days after injection of dogs with *Ancylostoma caninum* larvae, diminution of red corpuscles and increase of the substantia granulo-filamentosa are seen; no change is seen in the leucocytes, but in severe anemia they also diminish in number. The hematopoietic organs undergo conspicuous changes, especially the bone marrow, in which the red blood-cell group fairly decreases in severe cases. Infection of rabbits with cultured *Ancylostoma caninum* larvae does not cause anemia, but the .larvae which have passed through the lung of dogs cause anemia in rabitts, and changes in the hematopoietic organs.
N. Ishii.

196. Studies on the Habitats and Biology of *Demodex folliculorum*. (Japanese.) Shigeru OCHI. [Tokyo Iji Shsh., No. 2870 (1934), 690–698, 6 figs.] — *Demodex folliculorum* lives generally in the hair root of man, but sometimes comes out to the surface and moves about. The external auditory meatus is the favorable habitat, where the males are 0.240–0.285 mm and the females 0.355–0.385 mm long. N Ishii.

197. Studies on *Fasciolopsis buski* in China. (Japanese.) Hakuyo ZO. [Ni. Shokaki Gakkw. Z., **33**, No. 1 (1934), 46–59, 12 figs.] — *Planorbis coenosus* and *Segmentina largillierti* have been proved experimentally to be the first intermediate host; red water-caltrop, little crabs, clam and water-shield etc. the second intermediate host. N. Ishii.

198. The Identification of Formosan Anophelines. (Japanese with English summary.) Makoto KOIDZUMI and Kaoru MORISHITA. [Taiwan Ig. Kw. Z., **31**, No. 3 (1932), 283–288.] — After careful re-examination of many specimens and thorough collation of the literature, the following are given as occurring in Formosa. A few rare species still under discussion are excluded. 1) *Anopheles* (*Anopheles*) *hyrcanus* var. *sinensis* Wiedemann, 1828; 2) *A.* (*A.*) *lindesaii* Giles, 1900; 3) *A.* (*Myzomyia*) *minimus* Theobald, 1901; 4) *A.* (*M.*) *jeyporiensis* var. *candidiensis* Koidzumi, 1923; 5) *A.* (*M.*) *maculatus* Theobald, 1901; 6) *A.* (*M.*) *ludlowi* Theobald, 1903; 7) *A.* (*M.*) *fuliginosus* Giles, 1900; 8) *A.* (*M.*) *tessellatus* Theobald, 1901; 9) *A.* (*M.*) *maculipalpis* var. *splendidus* Koidzumi 1920. K. Morishita.

199. The Eggs of Formosan Anophelines. (Japanese with English summary.) Kaoru MORISHITA. [Taiwan Ig. Kw. Z., **31**, No. 3 (1932), 331–340, 1 pl.] — Eggs of *Anopheles hyrcanus* var. *sinensis*, *A. minimus*, *A fuliginosus*, *A. vagus*, *A. ludlowi*, *A. maculatus*, and *A. tessellatus* are described Author.

200. Studies on Trematodes whose Second Intermediate Hosts are Brackish Water Fishes of Formosa. 4th Report. On a New Trematode "*Monorchotrema yokogawai*" with Mullet as the Second Intermediate Host. (Japanese with English summary.) Isao KATSUTA. [Taiwan Ig. Kw. Z., **31**, No. 3 (1932), 253–265, 1 pl.] — This trematode was recovered from the small intestine of dogs and cats fed with the metacercariae found on the scales, gills and fins of the mullet. Experimental infection can be carried out in man, in whom natural infection is rare, because the metacercariae do not occur in the muscle of that fish.
K. Morishita.

201. Studies on Trematodes whose Second Intermediate Hosts are Brackish Water Fishes of Formosa. 5th Report. On a New Trematode "*Stellantchasmus amplicaecalis*" with Mullet as the Second Intermediate Host. (Japanese with English summary.) Isao KATSUTA. [Taiwan Ig. Kw. Z., **31**, No. 4 (1932), 457–471, 1 pl.] — A new heterophyid species obtained by feeding infected fish meat to dogs, cats and mice; it differs in several points from *S. formosanus* and *S. falcatus* already known. K. Morishita.

202. Experimental Studies on the Appearance of *Ascaris* Larvae in the Urine. (Japanese with English summary.) Yoshio ISHII and Rizai YAMASHIRO. [Taiwan Ig. Kw.

Z., **31**, No. 3 (1932), 271–282, 1 text fig.] — Feeding great numbers of *Ascaris lumbricoides* eggs containing mature larvae to rabbits led the authors to the following conclusions. 1) In heavy infections caused by feeding more than 200,000 eggs, some larvae almost always appear in the urine maybe as early as 24 hours after feeding, but in slight infections caused by less than 100,000 eggs, this is seldom the case. 2) The number of larvae which come out in the urine is proportionate to the number of eggs fed. K. Morishita.

203. **On Fecal Examination for Parasites of School Children of Chinese Parentage in Formosa, especially Medical and Biological Observations on *Ascaris lumbricoides*.** (Japanese with English summary.) Sadamu YOKOGAWA and Sei WAKESHIMA. [Taiwan Ig. Kw. Z., **31**, No. 5 (1932), 552–571; No. 6 (1932), 654–686, 1 text fig., 1 pl.) K. Morishita.

204. **Ein weiterer Fall von *Sparganum mansoni* auf ophthalmologischem Gebiet.** (Japanisch mit deutsch. Resume.) Chikô NARITOMI. (Taiwan Ig. Kw. Z., **31**, No. 8 (1932), 965–966.] — Ein Formosa-Chinese dessen Conjunctiva palpebralis oben und unten von diesem Parasiten befallen war. K. Morishita.

205. **Clinical Observation on 25 Cases of *Strongyloides stercoralis* in the Yaeyama Archipelago.** (Japanese with English summary.) Kozen YOSHINO. [Taiwan Ig. Kw. Z., **31**, No. 10 (1932), 1067–1080; No. 11 (1932), 1124–1138.]

206. **Über Cercarien als Parasiten von Schnecken in halbsalzigem Wasser, insbesondere über eine Art von cystophoren Cercarien. (Vorbericht.)** (Japanisch mit deutsch. Resume.) Isao KATSUTA. [Taiwan Ig. Kw. Z., **31**, No. 12 (1932), 1279–1282, 1 Taf.] — Eine Art von cystophoren Cercarien mit abweichender Körperbildung aus *Cerithium coralium* Kiener und *C. consisum humile* Dunker aus der Nähe von Tamsui (Formosa). K. Morishita.

207. **Über den Genitalnapf-Bauchsaugnapf-Apparat und dessen Adnexe, als einen für die zu *Stellantchasmus* gehörigen Trematoden eigentümlichen Apparat.** (Japanisch mit deutsch. Resume.) Isao KATSUTA. [Taiwan Ig. Kw. Z., **31**, No. 12 (1932), 1283–1288, 1 Taf.] — Vergleichung mit dem Apparat anderer Arten und Beitrag zur Kenntnis desselben. K Morishita.

208. **A New Subspecies and an Unrecorded Species of Lacebugs from Korea.** (Japanese.) Kôzo SAITO. (Chosen Hakub. Z., No. 15 (1933), 5–7.] — Description of *Stephanitis nashi* n. v. *suigensis* from Sui-gen, and a hitherto unrecorded *Cantacader lethierryi* Scott from Shun-sen, in central Korea, with notes on food plants of 7 species of Korean lacebugs. T. Mori.

209. **Further Studies on Korean Galls.** (Japanese.) Kôzo SAITO. [Chosen Hakub. Z., No. 15 (1933), 8–10.] — Further notes on 22 gall producing Cecidomyidae, Aphididae and other insects. T. Mori.

210. **Observations on Amphibia of Mok-po, Southern Korea.** (Japanese.) Toshishige KAMBE. [Chosen Hakub. Z., No. 15 (1933), 36–43.] — An account of the life history of *Bombina orientalis* Boulenger and the external structure and life history of *Hynobius* sp. T. Mori.

211. **A List of Korean Spiders collected by the Author.** (Japanese.) Toshishige KAMBE. [Chosen Hakub. Z., No. 15 (1933), 44–45.] — A nominal list of 24 species, referable to 8 families, of Korean spiders. T. Mori.

212. **On Some Unrecorded and New Aberrant Forms of Butterflies from Korea, and on the Variation of Wing Patterns in *Argynnis adippe* Linnaeus.** (Japanese.) Chumei SEKI. [Chosen Hakub. Z., No. 15 (1933), 73–77, 1 pl.] — Descriptions and figures of *Papilio protenor amaurus* Jordan and *Gonepteryx aspasia aspasia* Ménétriés f. *autum.-vern.*, both unrecorded; of *Papilio machaon* L. f. *aest.* ♂ *hippocrates* Felder, *Sericinus telamon montela* Gray f. *vern.* ♀,

Crysophanus disper auratus Leech ♂, all three aberrant, and variation of wing patterns in *Argynnis adippe* Linnaeus. T. Mori.

213. Some Aphididae, Hemiptera, from Korea. (Japanese with English description of a new species.) Ryoichi TAKAHASHI [Chosen Hakub. Z., No. 15 (1933), 78–79.] — A nominal list of 8 species, referable to 7 genera, of unrecorded Aphididae from Korea, with description of a new species, *Anuraphis valerianae* from Sui-gen, central Korea. T. Mori.

214. On the Variation of *Xylotrupes dichotomus* L. from Korea. (Japanese.) Fukusei CHO. [Chosen Hakub. Z., No. 15 (1933), 81–84, 1 pl.] – Figures of 12 specimens showing a continuous variation of external forms. T. Mori.

215. On Two New Bats from Korea. Tamezo MORI. [Chosen Hakub. Z., No. 16 (1933), 4–5.] – Descriptions of *Rhinolophus quelpartis* sp. nov. and *Murina hilgendorfi intermedia* subsp. nov. Author.

216. On Acipenseridae from Korea. (Japanese.) Tamezo MORI. [Chosen Hakub. Z., No. 16 (1933), 6–10, 1 fig.] — An annotated list of 3 Korean species of *Acipenser*, with key and distribution in far eastern Asia. Author.

217. Description of a New *Cicindela* from Korea. T. KANO and F. S. CHO. [Chosen Hakub. Z., No. 16 (1933), 17, 1 pl.] – Description of *Cicindela kaiyaensis* n. sp., from Kaiya, Kogen-do, central Korea. T. Mori.

218. A New Species of *Leptobotia*, Cobitinae, from Manchuria. Tamezo MORI. [Chosen Hakub. Z., No. 16 (1933), 13, 1 fig.] – *Leptobotia kudoi* sp. nov., closely allied to *L. mantschuricus* Berg, but differing from it in having deeper body, greatest depth twice the least depth, and the body sides without any crossband; from Sungari River near Kirin Author.

219. Miscellaneous Notes on the Cerambycidae of Korea. (Japanese.) Koichi TAMANUKI. [Chosen Hakub. Z., No. 16 (1933), 14–22.] Four sections: 1) On the Longicorn Beetles of Korea, by Kozo Saito; 2) On the Scientific Names of Several Species which need Correction; 3) On the Longicorn Beetles of Korea reported by Dr. Leo Hyrovsky; 4) On the Resemblance between the Longicorn Beetles of Northern Korea and those of Karafuto and Hokkaido. Discussion of scientific names of Korean longicorn beetles, and similarity of Korean longicorn beetles to those of Karafuto and Hokkaido. T. Mori.

220. Korean Tettigonidae, with Description of Two New Species. (Japanese.) Tamezo MORI. [Chosen Hakub. Z., No. 16 (1933), 50–56, 1 pl.] — Annotated list of 29 species, referable to 15 genera; *Tettigonia dolichoptera* and *Metrioptera koreana* are new. Author.

221. Life History and Culture Method of the Korean Snake-head, *Ophicephalus argus* Cantor. (Japanese with English résumé.) Keitaro UCHIDA and Masao FUJIMOTO. [Bull. Fish. Exp. Sta., Chosen, No. 3 (1933), 1–91, 6 pls., 12 figs.] — An account of life history, general habits and method of culture of the fish, with a short note on fishing method. T. Mori.

222. Notes supplémentaires à la révision des Ipides et Platypides de Corée II. Jozo MURAYAMA. [Chosen Hakub. Z., No. 15 (1933), 14–20.] — Un rapport des nouveaux renseignements, les formes des mâles avec leurs apparitions, les habitats ainsi que les plantes dévorées par ces insectes. Les espèces de Corée nouvellement decouvertes sont: *Xyleborus rubricollis* Eichhoff (de *Alnus tinctoria glabra*, à Chochiin), *Platypus lewisi* Blandford (de *Kalopanax ricinifolium*, à Koryo); les mâles premièrement découverts sont: *Xyleborus atratus* Eichhoff (de *Alnus tinctoria glabra*, à Chochiin) et *Xyleborus rubricollis* Eichhoff. Les autres sont: *Cryphalus exiguus* Blandford (de *Morus alba*, à Zenshû), *Xyleborus saxesseni* Ratzeburg (de *Alnus*

tinctoria glabra, à Chochiin) avec les mâles, *Xyleborus ebriosus* Niijima (de *Pinus koraiensis* et *Quercus* sp., à Koryo). Auteur.

223. Etude sur les organes génitaux des mâles du genre *Xyleborus*. Jozo MURAYAMA. [Chosen Hakub. Z., No. 15 (1933), 21–35, 1 pl.] — Études sur les organes génitaux mâles des *Xylebori* au point de vue morphologique et phylogénétique. L'auteur a étudié 5 espèces de Corée et les a comparé avec deux espèces européennes. Les espèces examinées sont: *Xyleborus atratus* Eichhoff, *X. dispar* Ratzeburg, *X. eurygraphus* Ratzeburg, *X. rubricollis* Eichhoff, *X. ebriosus* Niijima, *X. saxesseni* Ratzeburg et *X. octiesdentatus* Murayama. Les parties génitales mâles de ce genre sont arrangées successivement suivant le degré de variation de la "Rinne" soi-disante de Lindemann. La variation entre les 5 espèces de la Corée sont plus prononcée que chez les deux espèces européennes. Les deux extrémités de cette gradation tenderaient à les rapprocher à *Ips* et à *Dryocoetes*. Il serait préférable de trouver une méthode économique de détruire spécialement les mâles de ce genre que d'entreprendre la destruction générale de ces insectes si nuisibles aux forêts. Auteur.

224. Biology of *Nomonotus iwatai* (Hymenoptera, Psammocharidae). Kunio IWATA. [Ann. Zool. Jap., **13**, No. 4 (1932), 305–321, 2 pls.] — Life history and habits of the female of *Homonotus iwatai*, an external parasite of a spider, *Chiracanthium rufulum* Kishida. The wasp appears early in July, enters the breeding cell of the spider, stings the mother spider and deposits an egg on the dorso-proximal portion of its abdomen. The sting has no effect upon web spinning but interferes with oviposition. Z. Kuwana.

225. On the *Hynobius* of South Manchuria. Shiro KURASHIGE. [Ann. Zool. Jap., **13**, No. 4 (1932), 323–327, 2 figs.] - Description of a new species, *Hynobius manchuricus*, with slender body, teeth typical, vomero-palatine little elongated, head 1.4–1.2 as long as wide, rather acute snout, well developed fifth toe, tail longer than trunk and keeled above and below, thirteen costal grooves and typical egg sac. Z. Kuwana.

226. Observations cytologique sur la constitution d'une fibre musculaire lisse et particulièrement sur l'appareil de Golgi. Shiro KURASHIGE. [Ann. Zool. Jap., **13**, No. 4 (1932), 329–335, 1 pl.] — The Kolatchef-Nassonov as well as the da Fano method bring out the Golgi apparatus as a fine network by the side of nucleus (in *Hynobius* and *Trionyx*) and "appareil périnucléaire" (*Hynobius*, *Trionyx*, rat and frog). Z. Kuwana.

227. Some Histological Observation on the Submandibular Gland of the Rabbit. Kanichi NISHIOKA. [Ann. Zool. Jap., **13**, No. 4 (1932), 337–349, 3 pls.] — The gland is of purely serous nature. As to the morphology of the fundus of the gland, the branched tubulo-acini is the elementary component and the tubulo-saccular, gland-like structure is a pathological product. Z. Kuwana.

228. An Enormous Swarm of Stomatopod Larvae. Taku KOMAI. [Ann. Zool. Jap., **13**, No. 4 (1932), 351–354, 1 fig.] — Larvae, probably of *S. oratoria* de Haan, appeared in enormous numbers in the fall of 1930 on the north-western coast of Kii Peninsula. Z. Kuwana.

229. Über das Verhalten der Chondriosomen bei der mitotischen Zellteilung der jüngeren Blutzellen. Shunzo TAKAGI. [Ann. Zool. Jap., **13**, No. 4 (1932), 355–359, 1 pl.] — Chondriosomes were observed in the yolk sac of chick embryo. In the metaphase they are in two groups, one near each pole. In the anaphase they wander to near the equatorial plate and remain there in the divided daughter cell. Z. Kuwana.

230. On the Genus *Cirrodrilus* Pierantoni, 1905, with a Description of a New Branchiobdellid from Japan. Hideji YAMAGUCHI. [Ann. Zool. Jap., **13**, No. 4 (1932), 361–367, 3 figs.] — The presence of dorsal trunk and tentaculiform head appendages shows that *Cirrodrilus cirratus* Pierantoni should be placed in *Ceratodrilus*. *C. uchidai* nov. sp. resembles *C. cirratus*, but differs in having 12 trunk appendages and no supra-oral papillae. Z. Kuwana.

231. *Pseudobornella orientalis* nov. gen. et sp. from Japan. Kikutarô BABA. [Ann. Zool. Jap., **13**, No. 4 (1932), 369–376, 4 figs.] — External and internal structure of *Pseudobornella orientalis* and considerations on the diagnoses of the allied genera, *Bornella*, *Bornellopsis* and *Pseudobornella*. Characteristics of the new species: 1) tentacles divided into 2–4 long papillae; 2) rhinophore sheath with 2 short lateral and 1 very long posterior papillae; 3) simple undivided or non-papillated dorsal papillae provided with simple branchial leaflets; 4) presence of a denticulated masticatory process of the jaw plate; 5) only 2 lateral teeth in addition to a central tooth; 6) presence of denticles on the inner lateral tooth; 7) presence of only one stomach; 8) absence of hepatic prolongations in the dorsal papillae. Z. Kuwana.

232. A Note on Spiders from Southern Saghalien. Saburo SAITO. [Ann. Zool. Jap., **13**, No. 4 (1932), 377–385, 5 figs.] — Descriptions of *Araneus ventricosus*, *A. marmorea*, *A. patagiata*, *A. adianta*, *Zilla x-notata*, *Z. montana* and *Lycosa T-insignita*. Z. Kuwana.

233. A New Species of the Genus *Pseudococcus*. Sigeo KANDA. [Ann. Zool. Jap., **13**, No. 4 (1932), 387–390, 3 figs.] — Description of *Pseudococcus kuiensis* n. sp. characterized by the particular anal ring and numerous spines at abdominal end. Z. Kuwana.

234. Origin of the Eolidian Nematocysts from the Standpoint of Regeneration. Seiichi KOMORI. [Ann. Zool. Jap., **13**, No. 4 (1932), 391–397, 4 figs.] — Experiments on *Amphorina* sp. and *Aeolidiella takanosimaensis* have shown that the cerata can regenerate with or without food. In the former case, the regenerated cnidosac contains nematocysts, but not in the latter, proving the exogenous origin of eolidian nematocysts. Z. Kuwana.

235. Remark on the Viviparous Character of *Coeloplana*. Hideo TANAKA. [Ann. Zool. Jap., **13**, No. 4 (1932), 399–405, 1 fig., 1 pl.] – In Seto, no *Coeloplana mitsukurii* have been observed laying eggs. These are fertilized in the gastro-vascular spaces and the larvae are naturally discharged as development advances. Fertilization is perhaps effected by ripe male products discharged and carried into the gastro-vascular canal of another individual and meeting ripe eggs there. Z. Kuwana.

236. Note on the Parasitic Copepod *Herpyllobius*. Yô K. OKADA. [Ann. Zool. Jap., **13**, No. 4 (1932), 407–415, 1 fig., 1 pl.] — Morphology of a parasitic copepod closely allied to *Herpyllobius arcticus* attached to the ventral side of the middle of the body of *Polynoë pleiopsis*. The root system is massive and shaped like a short-fingered glove. Z. Kuwana.

237. *Ichthyotaces pteroisicola*, n. gen. et n. sp., a Copepod Parasitic on the Fish *Pterois lunulata* Temm. et Schl. Sueo M. SHIINO. [Ann. Zool. Jap., **13**, No. 4 (1932), 417–433, 10 figs.] — External and internal structure of *Ichthyotaces pteroisicola*, allied to *Sarcotaces*. In the gall formed by the dermal and subcutaneous connective tissue of the host one female occupies the greater part, but a dwarf male and numerous embryos are also found. Z. Kuwana.

238. Systematic Position of the Japanese Sculpins *Marukawichthys* and *Ereunias*. D. D. MUKERJI. [Ann. Zool. Jap., **13**, No. 5 (1932), 441–444.] — A new family Marukawichthyidae proposed by Sakamoto (1932) has no differential character from Cottidae. The genus *Marukawichthys* can be placed in the subfamily Ereuniinae, family Cottidae, by a slight emendation of the definition of Ereuniinae, "ventral fins wholly wanting" *or present*. Z. Kuwana.

239. On Two Species of Athecate Hydroids associated with Scorpaenoid Fishes. Taku KOMAI. [Ann. Zool. Jap., **13**, No. 5 (1932), 445–460, 2 figs., 3 pls.] -- *Podocorella minoi* and *Stylactis piscicola* n. sp., the latter with characteristic hydrorhiza made up of thicker reticulate stolons, slender gastrozooids, blastostyles, and gonophores of the eumedusoid type. Z. Kuwana.

240. Albinismo en Holoturioj. Hiroshi OHSHIMA. [Ann. Zool. Jap., **13,** No. 5 (1932), 461–466, 1 pl.] — An example of albinism in *Stichopus japonicus* Selenka.

241. Report on the Japanese Species of the Genus *Calantica* (Cirripedia). Fujio HIRO. [Ann. Zool. Jap., **13,** No. 5 (1932), 467–486, 5 figs., 1 pl.] — Descriptions of 4 species including 2 new species and 1 new subspecies: *Calantica quinquelatera* sp. nov., related to *C. villora* and characterized by the peculiar shape of latera of lower whorl, presence of subrostrum, and carina reaching to tip of scute; *C. krügeri* sp. nov. related to *C. eos* and *C. mortenseni,* with characteristic scutum, subcarina, peduncle and scales; *C. eos longisquama* subsp. nov. with elongate instead of rounded scales on peduncle; and *C. scorpio.* Z. Kuwana.

242. Some New Amphipods from Japan. K. STEPHENSEN. [Ann. Zool. Jap., **13,** No. 5 (1932), 487–501, 5 figs.] — Description of 3 new species, *Elasmopus japonicus* (Gammaridae) *Corophium uenoi* (Corophiidae) and *Vibilia seriocellatus* (Vibiliidae). Z. Kuwana.

243. A Contribution to the Study of the Mormyrid Cerebellum. Naokichi SUZUKI. [Ann. Zool. Jap., **13,** No. 5 (1932), 503–524.] — Microscopic anatomy of cerebellum of *Petrocephalus bane* and *Mormyrus caschive.* As an explanation of the frontal and the total enlargement of the cerebellum, it is suggested that the anlage of the cerebellum may perhaps be situated more frontalward in the early larval stage and at the same time, the excessive formation of the cerebellum, especially in the mormyrocerebellum of Franz, due to considerable reduction of the visual apparatus in bottom feeders, may have occurred accompanied by special development of the correlated fiber tracts of secondary and tertiary connections. Z. Kuwana.

244. Mayflies from Japanese Torrents. II. Further Notes on the Genus *Ameletus.* Kinji IMANISHI. (Ann. Zool. Jap., **13,** No 5 (1932), 525–533, 2 pls.] — Descriptions of 4 species including 3 new species: *Ameletus kyotensis* n. sp. distinguished from *A. montanus* by larger size and unpaired markings on sternites 3–6; *A. sapporensis; A. croceus* n. sp. allied to *A. kyotensis* and with basal halves of wings brownish; *A. subalpinus* n. sp. resembling *A. montanus* but distinguishable by brownish-bordered cross veins. Z. Kuwana.

245. Les possibilités de la régénération de la tête chez la Polychète, *Myxicola aesthetica.*(Clap.). Yô K. OKADA. [Ann. Zool. Jap., **13,** No. 5 (1932), 535–550, 9 figs.] — Regeneration of the head is possible at any part of the body, even near the posterior end. Each segment has an intense regenerating power and even a single isolated segment develops to a complete worm. Secondary head formation can be provoked, except in the anterior one-third of body, by sectioning the ventral nerve chain without separating the body, a difference from *Lumbriculus variegatus,* in which the section of the nerve chain provokes the formation of a head in the anterior part of body and a tail in the posterior. When an isolated cylinder composed of several segments is divided longitudinally into two, the half with the nerve chain produces a head after cicatrisation, the result being incomplete in the anterior one-third, owing partially to the presence of a head at the anterior end and partially to the character of the segments themselves. The presence of nerve is necessary for head formation. The alimentary canal has no relation to cephalic regeneration, though important for caudal. Z. Kuwana.

246. A New Species of the Genus *Kermes.* Sigeo KANDA. [Ann. Zool. Jap., **13,** No. 5 (1932), 551–557, 1 pl.] — Description of *Kermes kuwanae* n. sp. and key to Japanese species of the genus. Z Kuwana.

247. A Remarkable Dipterous Insect from Japan *Nymphomyia alba* gen. et sp. nov. Masaaki TOKUNAGA. [Ann. Zool. Jap., **13,** No. 5 (1932), 559–569, 1 pl.] — Representative of a new family Nymphomyiidae, with body like that of a certain caddice-fly larva and wings like those of thrips; the genus has a remote resemblance to Psychodidae and Cecidomyiidae. Z. Kuwana.

248. On a New Actinian, *Milne-Edwardsia akkeshi* n. sp., from Northern Japan.

Tohru UCHIDA. [Ann. Zool. Jap., **13,** No 5 (1932), 571-575, 4 figs.] — Characterized by the arrangement of tentacles and the structure of retractors. Z. Kuwana.

249. On Some Small Mammals collected on the Islands of Oki. Mitosi TOKUDA. [Ann. Zool. Jap., **13,** No. 5 (1932), 577-585, 1 fig., 1 pl.] — Descriptions of 4 species of Muridae and 1 of Talpidae: *Clethrionomys rufocanus okiensis* subsp. n., *Apodemus geisha celatus, A. speciosus navigator, Rattus rattus rattus* and *Urotrichus talpoides minutus* subsp. n. Z. Kuwana.

250. Pri Praveco de Uzo de Fluida Parafino por Esplori Spiradon de akvoj Bestoj. Nobuyuki KAWAMOTO. [Ann. Zool Jap., **13,** No 5 (1932), 587-609, 7 figs., 1 pl.] — Alkali-pyrogallic solution covered with liquid paraffin changes the color or absorbs oxygen. The absorption is more active at higher temperatures. Liquid paraffin in contact with air contains about three times as much oxygen as water in the same condition. Oxygen-content-time curve is a logarithmic one. Oxygen diffuses into water through liquid paraffin. Z. Kuwana.

251. Some Intestinal Parasites in the Duck from Japan. Seishun IWATA and Osamu TAMURA. [Ann. Zool. Jap., **14,** No. 1 (1933), 1-6, 2 figs.] — 5 trematodes, 4 cestodes and 2 nematodes. *Raillietina osakensis* is new and characterized especially by the number of testes (40-50 in each proglottid) and eggs (4 in each capsule). Z. Kuwana.

252. A New Species of *Lyroda* from Japan (Hymenoptera, Larridae). Kunio IWATA. [Ann. Zool. Jap., **14,** No. 1 (1933), 7-11, 1 pl.] — *Lyroda japonica* related to *L. venusta* and *L. formosa.* Z. Kuwana.

253. A Cestode Parasitic in *Plecoglossus altivelis.* Naokata KATAOKA and Kenji MOMMA. [Ann. Zool. Jap., **14,** No. 1 (1933), 13-22, 4 figs.] — Habit, external and internal structure and life history of *Proteocephalus* sp. from the intestine of *Plecoglossus altivelis.* The frequency of the parasite is 50-100% in spring but decreases from summer to spring. Z. Kuwana.

254. Testis-ovum in Anurans. Shigemori IRIKI. [Ann. Zool. Jap., **14,** No. 1 (1933), 23-27, 1 pl.] — Testis-ovum in *Bufo bufo japonicus, Rana nigromaculata, Rana rugosa,* and *Hyla arborea japonica.* Z. Kuwana.

255. A New Species of the Cicodidae from Formosa. (Hemiptera.) Teiso ESAKI. [Ann. Zool. Jap., **14,** No. 1 (1933), 29-33, 1 pl.] — External structure of *Tanna (Neotanna) ornatipenis* sp. nov. characterized by the markings on mesonotum and very conspicuous fascia on fore wings. Z. Kuwana.

256. On the Variability of Paragnathi in *Nereis mictodonta* Marenzeller (*Perinereis nuntia* var. *brevicirris* Grube). Sadae TAKAHASI. [Ann. Zool. Jap., **14,** No. 1 (1933), 35-40, 4 figs.] — Proboscis divided into eight parts; paragnathi vary so much in number and arrangement that they can not be made a specific character. Z. Kuwana.

257. A New Polychaete from Formosan Fresh-water. Sadae TAKAHASI. [Ann. Zool. Jap., **14,** No. 1 (1933), 41-46, 6 figs.] — Morphology and habits of *Lycastis longicirris* sp. nov., related to *L. hawaiensis.* Z. Kuwana.

258. Note on a Single-spined Specimen of the Heart-urchin, *Lovenia elongata* (Gray). Hayato IKEDA. [Ann. Zool. Jap., **14,** No. 1 (1933), 47-51, 2 figs.]

259. The Adult of the Bivalve-infesting Pycnogonid, *Nymphonella tapetis* Ohshima. Hiroshi OHSHIMA. [Ann. Zool. Jap., **14,** No. 1 (1933), 53-60, 4 figs.] — Morphology and taxonomy of the adult of *Nymphonella tapetis* previously known in an immature state. Z. Kuwana.

260. Young Pycnogonids found Parasitic on Nudibranchs. Hiroshi OHSHIMA. Ann. Zool. Jap., **14,** No. 1 (1933), 61-66, 5 figs.] — Young forms of *Ammothea* sp., infesting *Armina variolosa.* Z. Kuwana.

261. **Notes on Semper's Larvae found in the Vicinity of Seto.** Taku KOMAI. [Ann. Zool. Jap., **14**, No. 1 (1933), 67-77, 4 figs., 1 pl.] — Morphology of *Zoanthella*, *Zoanthina* and *Trochanthina bicincta* n. g., n. sp. Z. Kuwana.

262. **On Some Rats and Mice from the South Sea Islands. (Part 1. *Rattus concolor* Group.)** Mitosi TOKUDA. [Ann. Zool. Jap., **14**, No. 1 (1933), 79-87, 1 fig., 1 pl.] — First report on 32 specimens from Micronesia. *Rattus exulans* aud *R. micronesiensis* sp. nov., allied to *R. exulans* but smaller and darker, are described. Z. Kuwana.

263. **Einige Beobachtungen an den Chondriosomen bei Zyklostomen, *Entosphenus japonicus* (Martens).** Syunzô TAKAGI. [Ann. Zool. Jap., **14**, No. 1 (1933), 89-97, 1 pl.] — Observation on chondriosomes in winter materials of gill sac, liver, middle intestine, arachnoidal cells, muscles and other tissues. Z. Kuwana.

264. **Effect of pH on the Regeneration Polarity of the Tubularian Stem.** Seiichi KOMORI. [Ann. Zool. Jap., **14**, No. 1 (1933), 99-102.] — In the regeneration of *Tubularia mesembryanthemum*, the velocity of hydranth formation increases, and the rate of stolon formation decreases as pH increases from 5.8 to 9.2. Artificial reversal of the original polarity in regeneration was effected by exposing the proximal and distal halves to sea water of pH 8.45 and 6.0 respectively. Z. Kuwana.

265. **A Note on the Abnormal Nuclear Division of the normally Fertilized Eggs of the Echinoid (*Anthocidaris crassispina*) in Acid Media.** Hiroshi TAKAYA. [Ann. Zool. Jap., **14**, No. 1 (1933), 103 108, 2 figs.] — Cell division was retarded proportionally to the decrease of pH and suppressed at pH 6.3. In acid media, multicellular cells with irregular and abnormal nuclei appeared. Z. Kuwana.

266. **Freshwater Crustacea of Iturup.** Masuzo UENO. [Ann. Zool. Jap., **14**, No. (1933), 109-113, 1 fig.] — Notes on 5 known species belonging to 5 genera.

267. **Three Noticeable Fresh-water Crustacea of Hokkaido.** Masuzo UENO. [Ann. Zool. Jap., 14, No. 1 (1933), 115-122, 4 figs.] — Notes on a blind amphipod, a blind isopod and a new amphipod, *Paramoera yezoensis*, allied to *P. japonica*. Z. Kuwana.

268. **Notes on Fresh-water Medusae in Asia.** Tohru UCHIDA and Shigeru KIMURA. [Ann. Zool. Jap., **14**, No. 1 (1933), 123-126, 1 fig.].

269. **Drei neue parasitische Infusorien aus dem Darme einer japanischen Süsswasser-Oligochaete.** Yoshinobu MIYASHITA. [Ann. Zool. Jap., **14**, No. 1 (1933), 127-131, 4 figs.] — 3 new infusorians from *Criodrilus* sp., *Hoplitophrya criodrili*, *Protoradiophrya minuta* and *Ptychostomum bacteriophilum*. Z. Kuwana.

270. **The New Species of the Genus *Pseudococcus* from Yokohama and the Island of Palao.** Sigeo KANDA. [Ann. Zool. Jap., **14**, No. 1 (1933), 133-138, 8 figs.] — *Pseudococcus seruratus* and *P. palauensis*. Z. Kuwana.

271. **On an Interesting Collection of Trichoptera from Japan.** A. B. MARTYNOV. [Ann. Zool. Jap., **14**, No. 1 (1933), 138-156, 31 figs.] — 16 species, of which 9 species and 1 genus are new. Z. Kuwana.

272. **A Pelagic Nudibranch *Cephalopyge orientalis*, nov. sp. from Japan.** Kikutarô BABA [Ann. Zool. Jap., **14**, No. 1 (1933), 147-163, 1 pl.]

273. **Preliminary Note on the Nudibranchia collected in the Vicinity of the Amakusa Marine Biological Laboratory.** Kikutarô BABA. [Ann. Zool. Jap., **14**, No. 1 (1933), 165-179.] — Descriptions of 23 species. Z. Kuwana.

274. *Mesomyzostoma katoi*, n. sp., an Interesting Myzostoma found in the Gonad of *Comanthus japonicus*. Yaichiro OKADA. [Ann. Zool. Jap., **14,** No. 2 (1933), 185-189, 1 pl.] — A new species resembling *Mesomyzostoma reichenspergeri* and intermediate between *Protomyzostoma* and *Stelechopus*. Z. Kuwana.

275. Abnormalities in *Ceratium hirudinella* found in Hokkaidô, Japan. Yaichiro OKADA. [Ann. Zool. Jap., **14,** No. 2 (1933), 191-192, 1 fig.] — Two abnormal specimens, one with a divided antapical horn, the other with a divided right horn. Z. Kuwana.

276. On *Onychodactylus* from Korea. Tetsuo INUKAI. [Ann. Zool Jap., **14,** No. 2 (1933), 193-195, 1 fig.]

277. Remarks on the Secondary Sexual Characters of Brachyura. Yoshinobu MIYASHITA [Ann. Zool. Jap., **14,** No 2 (1933), 197-201, 1 fig.] — About 10% of *Eriocheir japonicus* de Haan was found infected by an epicaridan parasite. The infected crabs showed a slight asymmetry of carapace, the parasitized side being larger. The males had almost normal sexual characters. In the females, the abdomen showed a juvenile character (nearly triangular), and the ovary was reduced. It is concluded that the broadening of the abdomen beyond the juvenile state is conditioned by the maturation of the ovary. Z. Kuwana.

278. On the Epitocous Phase of the Nereid, *Perinereis nuntia* var. *brevicirris* Grube. Sadae TAKAHASI. [Ann Zool. Jap., **14,** No. 2 (1933), 203-209, 1 pl.] — Notes on the morphological changes and habits in the epitocous phase. Z. Kuwana.

279. Pycnogonids taken with a Tow-net. Hiroshi OHSHIMA. [Ann. Zool. Jap., **14,** No. 2 (1933), 211-220, 13 figs.] — Descriptions of 3 Japanese species of pelagic pycnogonids. The new species *Pallene amaxana* differs from the allied *P. producta* in the absence of eyes, and in the relative length of ambulatory legs. Z. Kuwana.

280. Ecological Reconnaissance of the Streams of Southern Kyûshû. Masuzo UENO. [Ann. Zool. Jap., **14,** No. 2 (1933), 221-233, 4 figs., 1 pl.]

281. Preliminary Notes on Some Small Mammals from Sado Island. Mitosi TOKUDA. [Ann. Zool. Jap., **14,** No. 2 (1933), 235-241, 1 pl.] — Description of 3 species of Muridae and 1 of Talpidae. Z. Kuwana.

282. Some Polychaete Annelids used as Bait in the Inland Sea. Shiro OKUDA. [Ann. Zool. Jap., **14,** No. 2 (1933), 243-253, 2 pls.] — Descriptions of 6 species belonging to 4 families. *Halla parthenopeia* is recorded for the first time from the Pacific. Z. Kuwana.

283. A New *Bembix* from Philippine Island. Keizo YASUMATSU. [Ann. Zool. Jap., **14,** No. 2 (1933), 255-258, 1 fig.] — External structure of *Bembix bazilanensis* n. sp. Z. Kuwana.

284. Additions to the Hymenopterus Fauna of the Ishigaki Island. Keizo YASUMATSU. [Ann. Zool. Jap., **14,** No. 2 (1933), 259-272, 6 figs., 1 pl.] — Notes on 10 species, including descriptions of 2 new species, *Ancistrocerus ishigakiensis* and *Rhynchium umenoi*, of the family Eumenidae. Z. Kuwana.

285. Supplementary Note on the Nudibranchia collected in the Vicinity of the Amakusa Marine Biological Laboratory. Kikutarô BABA. [Ann. Zool. Jap., **14,** No. 2 (1933), 273-283, 8 figs.] — Descriptions of 12 species, including a new species, *Baelidia japonica* (aeolid) Z. Kuwana.

286. Feeding Habit of *Hyla arborea japonica* Günther in Mulberry-tree Fields. (Japanese.) Suna NISIKAWA. [Sangyo Sik. Iho, No. 43 (1932), 1-41.] — The contents of the

alimentary canal were examined in 261 individuals. The greater part was insects (about 70 species), but spiders, snails and little grains of sand were also found. Coleoptera and Hymenoptera species were most numerous. *Eutettix discigutta* Walken (Hemiptera), *Propylea japonica* Thunberg, *Scymus patagiotus* Lewis, *Aenidia armata* Baly, *Phyllotreta funesta* Baly, *Aserica japonica* Waterhouse (Coleoptera) were frequent. 85% of the insects were species injurious to the mulberry tree.
Z. Kuwana.

287. New Tetranychid Mites attacking the Mulberry Leaf. I. Bionomics and External Structures of *Tetranychus suginamensis* n. sp. (Japanese with English résumé.) Kirio YOKOYAMA. [Bull. Imp. Sericul. Exp. Sta., **8,** No. 6 (1932), 229–287, 2 pls.]

288. Studies on the Dermestid Beetles of Japan. III. Bionomics and External Structures of *Attagenus ficeus* Olivier. (Japanese with English résumé.) Kirio YOKOYAMA. [Bull. Imp. Sericul. Exp. Sta., **8,** No. 6 (1932), 290–336, 3 pls.]

289. On the Epithelium of the Mid-gut in the Silkworm Larva. (Japanese with English résumé.) Jiro MACHIDA. [Bull. Imp. Sericul. Exp. Sta, **8,** No 7 (1933), 338–358, 2 figs., 3 pls.] — The epithelium consists of single-layered cylindrical and goblet cells, with interstitial cells near the basement membrane. The cylindrical cells contain many granular or filamentous chondriosomes and fat granules; the "Stäbchensaum" is acidophil. The goblet cells are largely filled each by a goblet, with the nucleus close to the base; goblet wall consists of chondriosomes and some acidophil components; neither chondriosomes nor fat granules are present in the cytoplasm. The cylindrical and goblet cells are formed from the interstitial cells. Protrusions of the cylindrical cells are artifacts due to fixation. The presence of fat globules in the cylindrical cells, their absence in the goblet cells and their reappearance as soon as the larva begins feeding after a moult, suggests that the cylindrical cells play a rôle in the absorption of nutrimnnts.
Z. Kuwana.

290. Genetical Studies on the Tetraploid Female in the Silkworm. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul. Exp. Sta., **8,** No. 7 (1933), 359–381, 1 fig.] — When a female heterozygous for yellow (Y), zebra (Z), and supernumerary (Kp) is mated with a male recessive to these genes and homozygous for d-oily (od) (sex-linked gene, dominating Z-chromosome), in normal case, in F_1 all females are d-oily, and all males are non-oily, and individuals of every combination of Y, Z, and Kp are equal in number. But if we incubate the eggs of this cross immediately after oviposition at 40°C for an hour, some of the eggs develop to females exceptional for normal inheritance, representing Y, Z, Kp and non-oily. The back cross of these exceptional females with the male od gives, in F_1, the segregation of the autosomal genes in the ratio of 5:1 or 1:1 for each of Y, Z, Kp. This result can be explained by assuming tetraploidy of the exceptional females as far as the autosomal genes are concerned. As to the segregation of sex and sex-linked gene, the ratio of females to males is 5:1, and the oilies and the non-oilies are equal in number in both sexes. These phenomena should indicate that the exceptional female carries in addition to the 4 sets of autochromosomes, 2 Z chromosomes, the one possessing od and the other its normal allelomorph and W carries dominant female factor. Cytological investigations indicate the triploidy of F_1, consequently the tetraploidy of the exceptional females.
Z. Kuwana.

291. Spiders from the Island of Rishiri and Rebun with Descriptions of Two New Species. Saburo SAITO. [Proc. Imp. Acad., **9,** No. 6 (1933), 273–276, 2 Textabb.] — Neun bekannte und zwei neue Arten: *Steatoda parvula* n. sp., *Tetragnata exquista* n. sp., *Theridion tepidariorum* C. L. Koch, *Linyphia emphana* Walckenaer, *Meta yunohamaensis* Bös. et Strand, *Araneus patagiatus* Clerck, *Araneus foliatus* Koch, *Cybaeus möllotée* (Simon), *Agalena japonica* Karsch, *Lycosa laura* (Karsch), *Lycosa annulata* Thorell.
K. Inoue.

292. Notes on the Growth of Cuticle in the Silkworm. Zyuiti KUWANA. [Proc. Imp. Acad., **9,** No. 6 (1933), 280–283, 3 Textabb.] — Die Kutikula des Seidenwurmes wächst fortdauernd. Die hypodermalen Zellen bilden immer Chitin und andere Substanzen, welche die Bestandteile

der Kutikula werden, nicht nur bei der Häutung sondern auch ununterbrechend durch das ganze Larvenleben. • K Inoue.

293. Über die Bildung des Harnstoffes aus Prolysin, Citrullin, verschiedenen Hydantoinen und aus Eiweißkörpern durch Einwirkung von Schwefelwasserstoff in schwach alkalischer Lösung. Mitsunori WADA und Noboru HAYAMA. [Proc. Imp. Acad., **9**, No. 7 (1933), 305–308.] — Den Verff. gelang durch Einwirkung von Schwefelwasserstoff den Harnstoff unmittelbar aus Eiweißstoff zu bilden. Verdünnte ammonialkalische Lösung wurde gebraucht, um den Eiweißstoff in Lösung zu bringen. Der gebildete Harnstoff wurde als freie Substanz oder als Nitrat, Oxalat, oder Dixanthylderivat gereinigt und identifiziert. K. Inoue.

294. Über *Botrydemnum tenue* n. g. n. sp., eine *Botrylloides*-ähnliche Didemnide. Asajiro OKA. [Proc. Imp. Acad., **9**, No. 7 (1933), 327–329, 1 Textabb.] — Eine neue Gattung, welche lange Zeit vom Verf. selbst für ein *Botrylloides* gehalten wurde. Die Kolonien bilden auf den Blättern von Padina sehr dünne, aus langgestreckten, geraden oder gewundenen Systemen bestehende Überzüge. K. Inoue.

295. The Variation of Chromosome-number in *Loxoblemmus arictulus*, a Species of Grylloid Family. Kazuo SUZUKI. [Proc. Imp. Acad., **9**, No. 7 (1933), 330–332, 2 Tab., 6 Textabb.] — Dreierlei Variationen kommen in den spermatogonialen Chromosomen vor: A) aus 4 J-förmigen, 10 stäbchenförmigen Chromosomen und 1 X-Chromosom bestehend; B) aus 4 J, 8 stäb., 1 X und 1 V-förmigem; C) aus 4 J, 6 stäb., 6 V und 1 X bestehend. Der Gruppe C gehörige, röntgenisierte Männchen wurden mit den normalen Weibchen gekreuzt. In F_1 kamen auch dreierlei Variationen vor: die Gruppe C; D) aus 4 J, 2 V, 6 stäb., 2 mikro-V und 1 X bestehend; E) aus 4 J, 2 V, 6 stäb., 1 mikro-V und 1 X bestehend. K. Inoue.

296. Notes on Sex in *Amphimermis zuimushi* Kab. et Im. Tokio KABURAKI and Kisabu IYATOMI. [Proc. Imp. Acad., **9**, No. 7 (1933), 333–336, 2 Tab.] — Wenn ein Wirt *Chilo simplex* viele Exemplare von *Amphimermis zuimushi* beherbergt, so sind die männchen zahlreicher, und umgekehrt falls nur wenige Parasiten vorgefunden werden. Intersexuelle Weibchen kommen öfters vor, aber keine intersexuellen Männchen. K. Inoue.

297. Notes on the Distribution of the Freshwater Pearl Mussel, *Margaritana margaritifera*, in Japan. Yaichiro OKADA and Kazuo KOBA. [Proc. Imp. Acad., **9**, No. 7 (1933), 337–339, 1 Textabb.] — Die Muschel kommt in Nordjapan, Sakhalin und Hokkaido sehr häufig vor, wird aber seltener südwärts; die Grenze ist in Japan 34° 17′ N. B. K. Inoue.

298. Wirkung des männlichen Sexualhormons auf Hahnenkamm und Samenbläschen. Kwanji MATSUZAKI. [Proc. Imp. Acad., **9**, No, 7 (1933), 342–344.] — Bei subkutaner Injektion der hormonhaltigen Lipoidlösung an kastrierten Ratten, regeneriert das Samenbläschen ziemlich regelmässig. Das Lipoidpräparat aus Männerharn ist auf Hahnenkamm wirksam. Der Hodenlipoidextrakt enthält wenigstens zwei verschiedene Hormone: eine leicht durch Oxydation unwirksam werdende, auf die sekundären Geschlechtsorgane wirksame Substanz und eine andere gegen Oxydation relativ widerstandsfähige, auf Hahnenkamm wirksame. K. Inoue.

299. Männliches Sexualhormon aus dem Hoden der Schweine. Akira OGATA und Shiro HIRANO. [Proc. Imp. Acad., **9**, No. 7 (1933), 345–346.] — Darstellungsmethode des Hormons. K. Inoue.

300. On *Hesperia bieti tokachiana* Matsumura, recently found in the Prov. Tokachi, Hokkaido. (Japanese.) Satoru KUWAYAMA. [Zephyrus, **3**, No. 1 (1931), 5–8.] — The newly discovered butterfly is redescribed and figured with some observations on other butterflies of Hokkaido. Teiso Esaki.

301. On Two Formosan Pierids and a Nymphalid. (Japanese.) Teiso ESAKI. [Zephyrus, **3**, No. 1 (1931), 12–15, 1 pl.] — *Delias hyparete peirene* Fruhstorfer, *Gonepteryx zaneka taiwana* Paravicini and *Apatura asakurai* Nire are figured in color, with biological notes.
Teiso Esaki.

302. Records of the Earlier Stages of Some Japanese Butterflies. (Japanese.) Kikujiro NAGANO, edited from his manuscript and with supplementary notes by Teiso ESAKI. [Zephyrus, **3**, No. 1 (1931), 16–27; Nos. 3/4 (1931), 207–211; **4**, Nos. 2/3 (1932), 174–180; No 4 (1932), 252–256; **5**, No. 1 (1933), 22–27, 5 pls.] — Earlier stages of the following Japanese butterflies are described and figured in color, with biological notes on the life history, posthumously published. Some notes, chiefly bibliographical, are supplemented by Esaki. *Papilio machaon* Linné, *Papilio bianor* Cramer, *Papilio demetrius* Cramer, *Luehdorfia japonica* Leech, *Colias hyale* Linné, *Terias hecabe* Linné, *Lethe sicelis* Hewitson, *Neope goschkevitschii* Ménétriés, *Neptis aceris* Lepechin, *Vanessa canae* Linné, *Zyrameis indica* Herbst, *Pyrameis cardui* Linné, *Vanessa xanthomelas* Esper, *Hestina japonica* Felder, *Arhopala japonica* Murray, *Lampides boeticus* Linné, *Cyaniris argiolus* Linné, *Pieris rapae* Linné, *Limenitis sibylla* Linné, *Libythea celtis* Laicharting, *Thanaos montanus* Bremer and *Rhopalocampta benjamini* Guérin. Teiso Esaki.

303. On *Sasakia charonda* Hewitson. (Japanese.) Akira KAWADA. [Zephyrus, **3**, No 1 (1931), 28, 1 pl.] — Photographs of larva, pupa and imago, taken from life.
Teiso Esaki.

304. Butterflies of South Manchuria. (Japanese.) Yasuo ARAKAWA. [Zephyrus, **3**, No. 1 (1931), 29–40.] — 97 species belonging to 6 families are enumerated, with figures of 11 species. Teiso Esaki.

305. On the Butterflies collected on the Route through the Pianan Pass, N. Formosa, with Notes on the Distribution of the "Alpine" Butterflies along the River Taikokei. (Japanese.) Ken-ichi NOMURA [Zephyrus, **3**, No. 1 (1931), 43–62.] — Faunistic and biological notes on the rarer butterflies collected by the author during his trip from Taiheizan via Pianan Pass to the Tôsei District in N. Formosa, in August 1930, with figures of some species and descriptions and figures of 3 new forms, *Arhopala ganesa formosana* Kato, *Euaspa milionia formosana* Nomura and *Zephyrus taiheizana* Nomura. Teiso Esaki.

306. Records of Butterflies in the Neighborhood of Sapporo in 1930. (Japanese.) Ichiro TANAKA [Zephyrus, **3**, No. 1 (1931), 63–64.] — The reappearance after over ten years of *Lycaena orion jezoensis* Matsumura at Tengudake, near Sapporo, Hokkaido, is of interest.
Teiso Esaki.

307. A New Aberrant Form of *Leptidia sinapis* Linné. (Japanese.) Waro NAKAHARA. [Zephyrus, **3**, No. 2 (1931), 95–96.] — A remarkable melanistic form, *Leptidia sinapis morsei* Fenton, ab. *yuasai* nov. from Sapporo, Hokkaido, is described and figured.
Teiso Esaki.

308. A New Aberrant Form of *Limenitis populi ussuriensis* Staudinger. (Japanese.) Iwahiko SUGITANI. [Zephyrus, **3**, No 2 (1931), 97–98, 1 pl.] — A remarkable melanistic form from Kamikochi, Prov. Shinano, Honshu, is described under the name ab. *sakaii* nov. and figured in color. Teiso Esaki.

309. Two Aberrant Forms of Japanese Butterflies. (Japanese.) Toyoji NAKAMURA. [Zephyrus, **3**, No. 2 (1931), 99–100, 1 pl.] — Two melanistic forms, *Neptis pryeri* Butler, ab. *kutsukakensis* nov. and *Neptis hylas intermedia* Pryer, ab. *uchidai* nov. are described and figured in color. Teiso Esaki.

310. On *Parnassius nomion* Fischer from Korea with a Note on a Melanistic Form. (Japanese.) Tamezo MORI. [Zephyrus, **3**, No. 2 (1931), 101–102.] — Enumeration of Korean races of this butterfly with figure of a melanistic form. Teiso Esaki.

311. Description of an Aberrant Form of *Papilio thaiwanus* Rothschild. (Japanese.) Takeo MITONO. [Zephyrus, 3, No. 2 (1931), 103, 1 pl.] — Description and colored figure of an aberrant male, ab. *e-fasciatus* nov. Teiso Esaki.

312. On Seven Formosan Butterflies. (Japanese.) Teiso ESAKI. [Zephyrus, 3, No. 2 (1931), 104–112, 2 pls.] — Colored figures of *Lethe dyrta daemoniaca* Fruhstorfer, *Lethe chandica ratnacri* Fruhstorfer, *Deudorix epijarbas menesicles* Fruhstorfer, *Abraximorpha davidii ermasis* Fruhstorfer, *Celaenorrhinus consanguinea ratna* Fruhstorfer, *Tagiades menaka cohaerens* Mabille and *Satarupa gopala majasra* Fruhstorfer, with biological and synonymic notes. Teiso Esaki.

313. Pupa of *Pareba vesta* Fabricius. (Japanese.) Kenzo KOBAYASHI. [Zephyrus, 3, No. 2 (1931), 113, 1 pl.] — Photographs from life of pupae and imagines just emerged are reproduced. Teiso Esaki.

314. Souvenir of the Collecting Trip to the Niitaka Mountain (Mt. Morrison), Formosa. (Japanese.) Ken-ichi NOMURA. [Zephyrus, 3, No. 2 (1931), 114–123.] — Narrative of the trip in July, 1930, with many biological and faunistic notes on butterflies Teiso Esaki.

315. Spring Butterfly Fauna of the Arisan Mountains, Formosa. (Japanese.) Kenzo KOBAYASHI. [Zephyrus, 3, No. 2 (1931), 129–133.] — Observations on the hitherto little known fauna, with biological notes on the rarer species. Teiso Esaki.

316. Butterflies of Minami-Daito Island (Loochoo). (Japanese.) Hirotaka YASHIRO. [Zephyrus, 3, No. 2 (1931), 145–146.] — Enumeration of 5 species of butterflies from this island, also called Minami-Ôagari Island, about 200 miles east of the main island of Okinawa, 25° 56′ N., 131° 13′ 20″ E. It is the first record of butterflies from this island Teiso Esaki.

317. *Coenonympha arcania* Linné, a Novelty to the Fauna of Japan, with Notes on the Japanese and Korean Species of the Genus *Coenonympha*. (Japanese.) Seinosuke UCHIDA. [Zephyrus, 3, Nos. 3/4 (1931), 165–169, 1 pl.] — The first record in Japan of this common European butterfly based on a single specimen from Nikko, on July 29th, 1931. Also description, revision and colored figures of 4 species of the genus occurring in Japan and Korea. Teiso Esaki.

318. On a New Subspecies of *Lycaena argus* from Japan Proper. (Japanese.) Kenzo KOBAYASHI. [Zephyrus, 3, Nos. 3/4 (1931), 107–171.] — *Lycaena argus hokiensis* subsp. nov. with figure. Teiso Esaki.

319. Curious Habit of *Lycaena argus*. (Japanese.) Seinosuke UCHIDA. [Zephyrus, 3, Nos. 3/4 (1931), 171.] — The facultative feeding habit of this butterfly on the sweat of travellers in the mountainous district near Yatsugatake, Prov. Shinano, is recorded and illustrated with a unique photograph Teiso Esaki.

320. A New Aberrant Form of *Chrysophanus phlaeas chinensis* Felder. (Japanese.) Einosuke ASANO. [Zephyrus, 3, Nos. 3/4 (1931). 172.] — Description and figure of an aberrant form of this butterfly from Chôfu, Honshu. Teiso Esaki.

321. Two New Aberrant Forms of Japanese "Alpine" Butterflies. (Japanese.) Shigeo KANDA and Yasushi FUJIMORI. [Zephyrus, 3, Nos. 3/4 (1931), 173–175.] — Descriptions and figures of *Erebia sedakovii niphonica* Janson, ♀-ab. *shinanensis* nov. and *Vanessa urticae connexa* Butler, ab. *kaiensis* nov. Teiso Esaki.

322. On *Papilio doson albidus* Wileman in the Province Tosa and a New Aberrant Form of *Pieris melete* Ménétriés. (Japanese.) Kiyomi HASHIMOTO [Zephyrus, 3,

Nos. 3/4 (1931), 176-182.] — Biological notes, with food plant, on the rare butterfly, *Papilio doson albidus* Wileman in Shikoku, and a description and figures of a remarkable melanistic form of *Pieris melete* Ménétriés, ab. *susakiensis* nov. Teiso Esaki.

323. **On Seven Formosan Butterflies.** (Japanese.) Teiso ESAKI. [Zephyrus, **3**, Nos. 3/4 (1931), 185-193, 2 pls.] — Colored figures, with biological and synonymic notes, of *Papilio febanus* Fruhstorfer, *Papilio cloanthus kuge* Fruhstorfer, *Huphina nerissa cibyra* Fruhstorfer, *Symbrenthia brabira acatinia* Fruhstorfer, *Apatura ulupi chrysolora* Fruhstorfer, *Eriboea narcaea meghaduta* Fruhstorfer and *Catapoecilma elegans moltrechti* Wileman. Teiso Esaki.

324. **Notes on Some Butterflies from Formosa, (2).** (Japanese.) Jinhaku SONAN. [Zephyrus, **3**, Nos. 3/4 (1931). 194-206, 3 pls.] — The pierid genus, *Betaporia* Matsumura, 1919, should be a synonym of *Metaporia* Butler, 1869. *Prioneris thestylis fumie* forma nov., *Prioneris thestylis formosana* Fruhstorfer, ab. *nivea* nov., *Danais limniace* Cramer, ab. *koshunensis* nov., *Danais limniace* Cramer, ab. *kurarensis* nov. and *Rapala koshunna* sp. nov. are described and figured. The genus *Mycalesis* of Formosa is revised with descriptions and figures of *Mycalesis francisca arisana* nov., *M. sangaica arisana* nov. and *M. mineus nitobei* nov. Teiso Esaki.

325. **Photographs of Japanese Butterflies, (2).** (Japanese.) Akira KAWADA. [Zephyrus, **3**, Nos. 3/4 (1931). 212-213, 2 pls.] — Photographs from life of the larvae, pupae and imagines of two hesperiids, *Thanaos montanus* Bremer and *Rhopalocampta benjamini japonica* Murray. Teiso Esaki.

326. **On the Pupa of *Curetis acuta* Moore.** (Japanese.) Keizo YASUMATSU. [Zephyrus, **3**, Nos. 3/4 (1931), 214-216.] — Description and figures of pupa. Teiso Esaki.

327. **Butterflies in the Vicinities of the Lakes Akan and Mashû, Hokkaido.** (Japanese.) Hiromichi KONO. [Zephyrus, **3**, Nos. 3/4 (1931), 217-220.] — 4 noteworthy species are enumerated, with figures of two; *Argynnis daphne mashuensis* subsp. nov. is described.
Teiso Esaki.

Abstracts

328. Über das Verhalten der Fette bei der Bebrütung von Hühnereiern. Kenzo KUSUI. [Jour. Biochem., **15**, No. 2 (1932), 319–323.] — Total fats decrease gradually as development proceeds. Free fatty acids reach the maximum on the 3rd day of development and then decrease gradually, but its amount is far greater in the embryo than in the other parts of the egg. The fatty acids obtained from eggs are mostly unsaturated. Y. Kimura.

329. Beiträge zur Embryochemie der Reptilien. Masaji TOMITA und Mitarbeiter. **IX. Über das Verhalten des Ovovitellins bei der Bebrütung des Meerschildkröteneies.** Kenzo KUSUI. [Jour. Biochem., **15**, No. 2 (1932), 325–330.] — The vitellin of the yolk may be utilized by the embryo for nutrition, as it distinctly decreases in quantity at the end of development. But its composition remains unchanged, the contents of tryptophan, tyrosin and cystin remaining constant throughout the developmental course. Y. Kimura.

330. Studies on Biochemical Reduction. I. A Preliminary Note on the Chemical Nature of an Active H_2-donator from Heart Muscle. K. KODAMA. [Jour. Biochem., **15**, No. 3 (1932), 473–476.] **II. Distribution of Biozuckerdehydrogenase in Various Tissues, with Special Reference to the Coenzymic Action of the Extract of Suprarenal Cortex.** Minoru TSUKANO. [Ibid., 477–455.] **III. The Redox-potential of Biozucker plus its Dehydrogenase.** Minoru TSUKANO. [Ibid., 487–490.] **IV. The Reduction of Cystine by the Biological Reducing System.** Minoru TSUKANO. [Ibid., 491–496.] — I) An extraction method and analytical data of the substance in question are given. Phenylhydrazin gives well defined crystals with the melting point of 138°C. The orcin test is positive. Nitrogen is absent. The sugar component of the molecule of the substance is glucose, not fructose. Specific rotation of Ba-salt gives the value $[\alpha]_D^{20} = +7.82$. The substance may be a hexosephosphoric acid but is not identical with Embden's Robison's ester. II) A codonator which intensely accelerates the action of the dehydrogenase in question was extracted from the suprarenal cortex of ox. III) The reduction potential of the heart muscle and the suprarenal cortex is greatly increased by the addition of the "biozucker". IV) Cystin can be reduced to cysteine by the system of "biozucker"+heart muscle in a greater degree than by the system of succinate+heart muscle, optimum pH being 7.4. Y. Kimura.

331. Über die Spezifizität der Schleimhautproteine des Verdauungstraktus des Schweines. Torajiro ASAO. [Jour. Biochem., **16**, No. 1 (1932), 17–47.]

332. Über die geschlechtlichen Unterschiede des Oxydations- und Reduktionsvermögens in den Geweben. (Zweite Mitteilung.) Sakae KAGIYAMA. [Jour. Biochem., **16**, No. 1 (1932), 99–104.] — In the skeletal muscles of rabbits oxydase granules are more numerous and the oxygen comsumption are greater in the male than in the female.
Y. Kimura.

333. Nutritional Study on Dermestid Beetles. I. The Chemical Composition and especially the Nature of the Ether Extract of Beetles. Osamu SINODA and Masao KURATA. [Jour. Biochem., **16**, No. 1 (1932), 129–139.] — *Dermestes coarctatus* and *D. vulpinus* and their larvae (mixed) were fed with the dried preparation of bonito fish (Katsubushi), and the contents of water, various forms of nitrogen and oily substances were estimated. The great accumulation of oily matter found in the insect body seems to be derived (at least partly) from the protein of the food by desamination. The physical and chemical characteristics of the oils of the beetles differ from those of Katsubushi oil, but are rather near to those of the oil of herbivorous beetles such as *Cetonia*. The water and nitrogen contents decrease as the insects grow older. Y. Kimura.

334. Über die geschlechtlichen Unterschiede des Oxydations- und Reduktions-

vermögens in den Geweben. (Vierte Mitteilung.) Über die geschlechtlichen Unterschiede des Oxydations- und Reduktionsvermögens in den Geweben des Hühnerembryos. Sakae KAGIYAMA. [Jour. Biochem., **17**, No. 1 (1933), 135–146.] — Am etwa 12–13ten Bruttage wird das Oxydationsvermögen beim männlichen Hühnerembryo stärker als beim weiblichen; das Reduktionsvermögen dagegen beim männlichen schwächer als beim weiblichen. Diese geschlechtlichen Unterschiede treten am deutlichsten im Herzen auf. Y. Kimura.

335. Über das Schicksal der Dehydrocholsäure im Krötenorganismus. Shigetoshi SHIBUYA. [Jour. Biochem., **17**, No. 3 (1933), 385–390.] — Den Sommerkröten wurde Natriumdehydrocholat (je 3–5 cm einer 1%igen Lös.) subkutan verabreicht. Aus dem Harn wurden perlmutterglänzende Nadelkristalle erhalten, welche höchstwahrscheinlich diejenigen der Diketoxycholansäure sind, und im Krötenorganismus entweder durch die direkte Reduktion der Dehydrocholsäure oder durch die stereoisomerischen Verwandlung der zuerst entstandenen Redukto-(3)-Dehydrocholsäure gebildet zu werden scheinen. Y. Kimura.

336. I. Beiträge zur Embryochemie der Amphibien. Masaji TOMITA u. Hidekatsu FUJIWARA. [Jour. Biochem., **17**, No. 3 (1933), 401–405.)]. **II. Physikalische Eigenschaften der Perivitellinflüssigkeit des Riesensalamandereies.** Hidekatsu FUJIWARA u. Shigeru TSUNOO. [Jour. Biochem., **17**, No. 3 (1933), 407–408.]. **III. Über das Verhalten der anorganischen Bestandteile bei der Bebrütung des Riesensalamandereies.** Toshimori ISEKI u. Teki KUMON. [Jour. Biochem., **17**, No. 3 (1933), 409–411.] **IV. Über das Verhalten der N-haltigen Verbindungen bei der Bebrütung des Riesensalamandereies.** T. ISEKI, T. KUMON, I. TAKAHASHI u. F. YAMASAKI. [Jour. Biochem., **17**, No. 3 (1933), 413–415.] **V. Über den Kohlehydratstoffwechsel bei der Bebrütung des Riesensalamandereies.** Eisei KATAOKA u. Shigeru TSUNOO. [Jour. Biochem., **17**, No. 3 (1933), 417–418.]. **VI. Über das Verhalten der Fettsubstanzen bei der Bebrütung des Riesensalamandereies.** E. KATAOKA u. I. TAKAHASHI. [Jour. Biochem., **17**, No. 3 (1933), 419–422.] — I. Einleitende Betrachtung. Das Gewicht des Embryos, das ungefähr 3.5–4.0% des Gesamtgewichts beträgt, ist hauptsächlich vom Wassergehalt (ca. 50–65%) abhängig, der seinerseits der Fettsubstanz umgekehrt proportionell ist II. Die Perivitellinflüssigkeit ist dünnflüssig, wasserklar und farblos, und reagiert neutral (pH=7.1), nur im Endstadium der Bebrütung schwach sauer (pH=6.9). Das spezifische Gewicht ist beinahe gleich dem des Wassers. III. Im letzten Entwicklungsstadium nehmen sowohl die Gesamtasche als auch die anorganische Phosphorsäure bedeutend zu, der Kalkgehalt aber erreicht schon am Anfang des Entwicklungsstadiums sein Maximum. IV. Die Gesamt- und Reststickstoffmengen sind im Vergleich zum Hühner- und Reptilienei auffallend gering; der Rest-N nimmt beträchtlich im letzten Entwicklungsstadium zu; Kreatin und Kreatinin sind nur spurweise nachweisbar. V. Im späteren Entwicklungsstadium nimmt das Glykogen ab, also scheint das letztere während der Bebrütung als Energiequelle zu dienen. VI. Es fällt auf, dass im Spätstadium der Entwicklung ein Zunehmen der freien Fettsäure und ein Abnehmen der Verseifung stattfinden; die energetischen Bedürfnisse des Embryos scheinen zum Teil durch die Neutralfette befriedigt zu werden. Gleichzeitig finden sich eine stetige Abnahme des freien Cholesterins und eine Zunahme des Cholesterinesters. Y. Kimura.

337. Chemie der Gastropodeneier. Teki KUMON. [Jour. Biochem., **18**, No. 1 (1933), 145–151.] — Bei der Entwicklung erfährt die Gesamtstickstoffmenge des ganzen Eiinhaltes von *Hemifusus tuba* eine nur allmähliche Zunahme, aber die Reststickstoffformen nehmen, wie beim Vogel- und Reptilienei, bedeutend zu, obwohl deren absolute Menge sehr gering ist. Der Aschengehalt, vor allem der Kalk, nimmt im späteren Stadium beträchtlich zu. Y. Kimura.

338. Über den Cholesterin-Gehalt der Muskulatur von Fischen. Seishiro NAMIKI. [Jour. Biochem., **18**, No. 1 (1933), 163–171.] — Der Cholesteringehalt im roten Fleische (0.103–0.146%) ist höher als im gewöhnlichen (0.035–0.077%). Die angewendeten Fischarten waren Lachs, Schlegel, Meeräsche, Makrele, Thunfisch, u. s. w. Y Kimura.

339. Vorkommen der Taurocholsäure in der Hühnergalle. Kazumi YAMAZAKI. [Jour. Biochem., **18**, No. 2 (1933), 323–324.]

340. Der Einfluss der Temperatur auf den Eiweißstoffwechsel. II. Die stickstoffhaltigen Extraktivstoffe der Krötenleber während der Winterzeit. Hiroshi MAKINO. [Jour. Biochem., **18**, No. 3 (1933), 387–393.] — Das Leucin und das Valin sind die Hauptbestandteile der Winterleber. Die verstärkte Glykogenbildung in der Winterleber dürfte auf dem größeren Gehalt an diesen Aminosäuren beruhen. Das in der Sommerleber am stärksten vertretene Tyrosin ist in der Winterleber nur spurweise vorhanden. Y. Kimura.

341. Zur Kenntnis der Konstitution des Ovomukoides. Toshinori ISEKI. [Jour. Biochem., **19**, No. 1 (1934), 1–5.] — Aus Ovomukoid wurde eine schneeweiße, nicht hygroskopische Substanz (die reduzierende Muttersubstanz Komori's), durch lange Trypsinverdauung dargestellt. Sie ist noch spurweise aschenhaltig, und positiv gegen die Biuretreaktion, aber von Aminosäuren frei. Die Chitosamingehalt beträgt 19.43%. Die elementaranalytischen Data sind angegeben.
Y. Kimura.

342. Chemische Zusammensetzung der Schweinthymus. Eisei KATAOKA. [Jour. Biochem., **19**, No. 1 (1934), 21–24.] — Im Gegensatz zum β-Stearo-Dipalmitin, das von Karashima (1928) aus der Rinderthymus dargestellt worden ist, wurde α-Palmito-Distearin aus der Schweinthymus kristallinisch isoliert. Unter den fraktionierten Aminosäuren befinden sich die Hexonbasen und das Leucin reichlichst. Glykokoll liess sich nicht nachweisen. Y. Kimura.

343. Vergleichende Untersuchung der chemischen Zusammensetzung des Pankreas. Eisei KATAOKA. [Jour. Biochem., **19**, No. 1 (1934), 25–32.] — Beim Schwein und Rind kann man keinen auffallenden Unterschied in den Eiweißbausteinen des Pankreas finden. Bei beiden Tierarten ist aber bemerkenswert, dass das Leucin und die Hexonbasen an Quantität überwiegen. In Bezug auf die Fettstoffe, so liess sich β-Stearo-Dipalmitin aus dem Rinderpankreas, und β-Lauro-α-Distearin aus dem Schweinpankreas isolieren. Y. Kimura.

344. Beiträge zur Kenntnis der Taurocholsäure aus Fischgalle. Hiroshi MAKINO. [Jour. Biochem., **19**, No. 2 (1934), 249–251.] — Die frische Galle von *Seriola quinqueradiata* wurde verarbeitet. Y. Kimura.

345. The Effect of Adrenalin on the Liver Glycogen in Adrenalectomized Rabbits. Juniti ASAEDA and Paul T. SHEN. [Jour. Biochem., **19**, No. 3 (1934), 391–401.] — The glycogen content of the liver and muscle is nearly unaffected, though a temporary increase of blood sugar follows. Y. Kimura.

346. Fossil Mammals and Human Artefacts excavated near Harbin, Manchukuo. Shigeyasu TOKUNAGA and Nobuo NAORA. [Proc. Imp. Acad., **9**, No. 8 (1933), 404–406, 5 Fig.] Zähne der fossilen *Felis, Canis, Hyaena, Microtus, Ochotocoides, Siphneus, Rhinoceros tichorhinus* Cuv., *R.* sp., *Equus, Capreolus, Sus, Bison, Bubalus, Bos, Elephas* cfr. *primigenius* Blum wurden in Anzahl gefunden; auch 5 interessante Steinwerkzeuge von alten Menschen.
K. Inoue.

347. On the Seasonal Change of Growth in Some Paleozoic Corals. Ting Ying H. MA. [Proc. Imp. Acad., **9**, No. 8 (1933), 407–409, 6 Fig.] — Verf. ist der Meinung, dass die von ihm an der Interseptalgewebe von paläozoischen Korallen aus Gotland, Deutschland und England bemerkte periodischen Wachstumsveränderungen auf die verschiedenen Wassertemperaturen der Jahreszeiten zurückzuführen ist. K. Inoue.

348. Preliminary Notes on the Chromosomes of *Rana limnocharis*. Ikio SATO. [Proc. Imp. Acad., **9**, No. 8 (1933), 422–423, 5 Fig.] — *Rana limnocharis* kommt nur in der südlichen Hälfte der japanischen Inseln vor. Das Material stammte ausschliesslich aus der Umgebung von Hiroshima. Die Aequatorialplatte der spermatogonialen Metaphase besteht aus 26 bald V-förmige, bald J- oder stäbchenförmigen Chromosomen. Bei der Metaphase der ersten Spermatozyten befinden sich 13 Chromosomen, von denen nur eins sehr gross und V-förmig ist und als das Geschlechtchromosom betrachtet wird. Auch bei den zweiten Spermatozyten sind 13 Chromosomen vorhanden. K. Inoue.

349. Preliminary Note on the Inheritance of Scale Transparency in Goldfish in Japan. Yoshiichi MATSUI. [Proc. Imp. Acad., **9**, No. 8 (1933), 424-427, 8 Tab.] — Gewöhnlich hat der Goldfisch Schuppen mit Iridozystschicht. Bei einer Abart aber fehlt diese Schicht, so dass die Schuppen vollständig durchsichtig sind, und bei einer anderen kommen beiderlei Schuppen mosaikartig nebeneinander vor. 1927 fand Verf. Mutanten mit durchsichtigen Schuppen, an denen die Iridozystschicht netzartig angeordnet war. Durch Kreuzungsversuche wurde das Genom dieser Abart folgendermaßen analysiert: der Goldfisch mit sämtlich durchsichtigen Schuppen besteht aus TTNN, TTNn, oder TTnn, mit mosaikartig durchsichtigen aus TtNN, TtNn, oder Ttnn, mit normalen aus ttNN, ttNn, und mit netzartig durchsichtigen ttnn, wo T das Gen des Charakters von durchsichtigen Schuppen und t das von normalen Schuppen zeigt. Das n bedeutet das Gen vom Charakter der netzartigen Schuppen und N das allelomorphische Gen gegen n. K. Inoue.

350. On the Structure of Compound Eyes in the Rice-borer Moth, *Chilo simplex* Butler. Shohei SUGIYAMA. [Proc. Imp. Acad., **9**, No. 8 (1933), 428–431, 8 figs.] — The fixative mostly used was a mixture of formalin, alcohol and glacial acetic acid, the stains Heidenhain's iron hematoxylin. The eye is of the type yielding a superposition image and has complicated rhabdom and very large accessory pigment cells containing a large amount of pigment. The ommatidium presents many differences in its features according as it is light-adapted or dark-adapted. A multinucleated retinular part and the pigments of the principal and accessory pigment cells are found to change their position in accordance with the amount of light.
Author-Inoue.

351. Notes on the Chemotactic Response of *Rhabditis filiformis* Bütschli. Ryoseki TANIGUCHI. [Proc. Imp. Acad., **9**, No. 8, 432–435, 5 Tab.] — Das Material wurde auf der Agarplatte kultiviert. Viele Säuren, Alkalien, Salze, Alkohol und Chloroform sind chemotaktisch wirksam, manche Farbstoffe aber nicht. K. Inoue.

352. Ein Fall von Kolonialknospung bei einer Synascidie. Asajiro OKA. [Proc. Imp. Acad., **9**, No. 8 (1933), 436–438, 2 Fig.] — Die Einzeltiere von *Distoma proliferum* n. sp. zeigt keine bemerkenswerten Bau, aber jede Kolonie trägt eine Anzahl von Knospenauswüchse, die allmählich wachsen und zu pilzförmigen, von der Oberfläche der Kolonie hervorragenden Gebilden werden und schliesslich sich von der Mutterkolonie lostrennt, um neue Kolonien zu bilden. K. Inoue.

353. A Note on the Structure and Function of the Anterior Region of the Alimentary Canal of the Larval and Adult *Molge vulgaris*. Yaichiro OKADA. [Proc. Imp. Acad., **9**, No. 8 (1933), 439–442, 2 Fig.] — Am vorderen Teil des Verdauungskanals ist die Muskelschicht sehr wenig entwickelt. Das Zilienepithel ist in der Speiseröhre und der Cardia vorhanden, fehlt aber an der Pylorusgegend. In der Tela mucosa der Speiseröhre kann man viele Drüsenzellen und im Magen Magensaftdrüsen finden. Das pH der Speiseröhre ist etwa 7.2–7.4, das des Magens 7.8. Der Extrakt der Speiseröhre enthält amyloytisches, der Magenextrakt aber proteolytisches Enzym. Der Larvenmagenextrakt hat aber keine proteolytische Wirkung. K. Inoue.

354. Notes on the Mixed Fauna of Tropical and Boreal Animals in Honsyû, Japan. Yaichiro OKADA and Kazuo KOBA. [Proc. Imp. Acad., **9**, No. 8 (1933), 443–445.] — Als Beispiele der tropischen Elemente führen Verff. folgende an: *Rhacophorus schlegeli arborea* (Okada und Kawano), *Rana limnocharis* (Wiegmann), *Geotelphusa dehaani* (White), *Macaca fuscata* (Blyth), und als Beispiele der nördlichen Elemente, *Margaritana margaritifera* (Linné), *Lepus brachyurus etigo* Abe. K. Inoue.

355. Notes on Two Species of the Family Myrmeleontidae. Satoru KUWAYAMA. [Proc. Imp. Acad., **9**, No. 8 (1933), 446–449, 2 Fig.] — Beschreibung von *Palpares pardus* var. *asanai* nov., gefangen in der Umgegend von Bombay, und *Euroleon polyspilus* Gerstaecker aus Sachalin. K. Inoue.

356. Eine Neue Becherqualle aus Hokkaido. Tohru UCHIDA. [Proc. Imp. Acad., **9,** No. 8 (1933), 450–452, 1 Fig.] — Beschreibung von *Halyclystus borealis* n. sp K. Inoue.

357. Einfluss des Ikterus auf die Entwicklung von *Schistosoma japonicum* im Wirtskörper. Taro SONODA. [Proc. Imp. Acad., **9,** No. 8 (1933), 453–456.] — Der Ikterus wurde an Kaninchen durch die Unterbindung des Ductus choledocus hervorgerufen, und in verschieden langen Zeiträumen danach, wurde die Invasion der ikterischen Haut von den Cercarien herbeigeführt. Wenn der Ikterus sich noch im früheren Stadium befindet, so können die Cercarien während 4 Tage die Haut passieren, aber im späteren Stadium sterben die Würmer sämtlich im Hautgewebe. Das ikterische Hautgewebe reagiert gegen die Invasion mit entzündlicher Zellinfiltration. K. Inoue.

358. Transmission of the Virus through the Eggs of an Insect Vector. Teikichi FUKUSHI. [Proc. Imp. Acad., **9,** No. 8 (1933), 457–460, 1 Tab.] — Durch Experimente ist Verf. zum Schluss geführt worden, dass der Virus von Zwergkrankheit der Reispflanze durch die Eier von *Nephotettix apicalis* Motsch var. *cincticeps* Uhl übertragen werden. K. Inoue.

359. Discovery of *Spirifer verneuili* Murchison in Japan. Hisakatsu YABE and Mitsuo NODA. [Proc. Imp. Acad., **9,** No. 9 (1933), 521–523, 6 Fig.] — In der Prafektur Iwate haben Verff. Exemplare von *Spirifer* (*Trigonotreta*) *verneuili* Murchison, *Chonetes hardenensis* Phillips und *Rhynchonella pleurodon* Phillips gefunden. K. Inoue.

360. Crossing-over in the Males of *Drosophila virilis*. Hideo KIKKAWA. [Proc. Imp. Acad., **9,** No. 9 (1933), 535–536.] — Man hat lange an Männchen von *Drosophila melanogaster* und *D. simulans* "crossing-over" nicht gefunden. Aber die homologen Chromosomen von *D. virilis* haben gegeneinander sehr starke Affinität, nicht nur bei Weibchen sondern auch bei Männchen, und es ist dem Verf. gelungen, durch Kreuzung "crossing-over" auch beim Männchen auftreten zu lassen. K. Inoue.

361. Is *Nomeus* a Harmless Inquilinus of *Physalia*. Kojiro KATO. [Proc. Imp. Acad., **9,** No 9 (1933), 537–538.] — Der Fisch ernährt sich von den Zooiden. K. Inoue.

362. *Ctenoplana* from Japan. Narao YOSII. [Proc. Imp. Acad., **9,** No. 9 (1933), 539–540, 2 Fig.] — Einfache Beschreibung von *Ctenoplana maculomararinata* und *Ctenoplana maculosa*, beide in Misaki vorkommend. K. Inoue.

363. Sur une Ichthyobdellide nouvelle trouvée dans le plancton. Asajiro OKA. [Proc. Imp. Acad., **9,** No. 9 (1933), 541–543, 2 Fig.] — Beschreibung einer neuen Art von marinen Blutegeln, *Carcinobdella bimaculata*. K. Inoue.

364. Preliminary Note on the Mendelian Inheritance of the Telescope Eyes in the Gold-fish of Japan. Yoshiichi MATSUI. [Proc. Imp. Acad., **9,** No. 9 (1933), 544–547, 8 tabs.] — Crossing experiments show that the telescope-eyed character is dominant over the normal-eyed and that the normal-eyed character of "funa" acts as inhibiting factor for the development of the telescope-eye. K. Inoue.

365. Two Cases of Sexual Abnormalities in *Homeogryllus japonicus* de Haan. Kazuo SUZUKI. [Proc. Imp. Acad., **9,** No. 9 (1933), 548–551, 1 text fig., 3 pls.] — Description of sexual abnormalities caused by X-ray treatment. K. Inoue.

366. Pharmakologische Untersuchungen über "Senso", eine chinesische Droge aus abgetrocknetem Hautsekret der Kröte. I. Mitteilung. Yoshihito KOBAYASHI. [Proc. Imp. Acad., **9,** No. 9 (1933), 552–555, 4 Fig.] — Auf isolierte Froschherzen wirken die aus "Senso" dargestellten Präparate cardiotonisch wie Digitalis. Die bei den Experimenten angewendeten Senso-Präparate waren ψ-Bufotalin, Des-Acetyl-ψ-Bufotalin, ψ-Bufotalin-Bromid, Des-Acetyl-ψ-Bufotalinchlorid, Monoacetyl-ψ-Bufotalin, Monoacetyl-Desacetyl-ψ-Bufotalinchlorid, Anhydro-

ψ-Bufotalinchlorid, ψ-Bufotalon, ψ-Bufotoxin, Des-Acetyl-ψ-Bufotalinsäure, Des-Acetyl-ψ-Bufotalonsäure, und Tetrahydro-ψ-Bufotalin. K. Inoue.

367. **Über den Schwellenwert bei elektrischer Reizung der Herznerven.** Tetsuichiro HASEGAWA. [Jap. Jour. Med. Sci., III. Biophys., 2, No. 4 (1933), 271-306, 33 Fig., 11 Tab.] — Ein Nerven-Sinus-Präparat vom Krötenherzen wurde in ein zweifächeriges Kästchen gelegt. Der Sinus wurde im einen Fach in der Versuchslösung, und der Nerv wurde in einem kleinen Loch in der Mitte der Scheidewand im anderen Fach in der Ringerlösung gelegt. Die beiden Fächer waren wasserdicht von einander getrennt, indem das Loch der Scheidewand mit Fett geschlossen wurde. Die Reizung des Sympathicus geschah am Grenzstrang durch tetanisierende Induktionsströme mit einer Flüssigkeitselektrode nach Hashida, und der Schwellenwert für befördernde Wirkung auf den Sinus wurde bestimmt. Der Sinus wurde mit verschiedenen Versuchslösungen von V. cava post. aus unter konstantem Druck durchgespült, während die Flüssigkeit zwanglos von den geschnittenen Gefäßöffnungen sowie der offen gelassenen Sinoauriculargrenze in Tauchlösung für den Sinus ausfloß. Die Reizschwelle bei der tetanisierenden Reizung, die nach dem Rollenabstand eines Schlitteninduktoriums abgelesen wurde, erfuhr durch Ersetzung der durchspülenden Ringer'schen Lösung mit einer Versuchslösung, die $CaCl_2$, KCl, Acetylcholin oder Adrenalin in verschiedener Konzentration enthielt, überhaupt keine Verschiebung, während die Schlaggröße selbst dadurch mannigfach auffallend beeinflusst wurde. Allein wenn die Konzentration so stark ist, dass sie den Stillstand des Sinusschlages (Kalium, Acetylcholin), resp. die maximale Beförderung (Adrenalin) hervorruft, so nimmt der Rollenabstand für die Schwellenreize plötzlich mehr oder weniger stark ab und kann unter Umständen selbst Null erreichen. Autor-Inoue.

368. **Beiträge zur Kenntnis der elektrotonischen Ströme.** Masao SUZUKI. **I. Mitteilung. Normales Verhalten.** [Jap. Jour. Med. Sci., III. Biophys., 2, No. 4 (1933), 307-345, 8 Fig., 7 Tab.] **II. Mitteilung. Das Verhalten unter der Narkose.** [Ebenda., 347—423, 11 Fig., 10 Tab.] — I. Ausführliche Untersuchungen über die elektrotonischen Ströme am N. abdominalis von *Bufo vulgaris formosus*. Dieser Nerv ist für solche Versuche geeignet, weil er keine Verästelung erfahrt und in seinem ganzen Verlauf fast gleichmäßig dick ist. Was das zeitliche Verlhältnis anbelangt, so nimmt der Anelektrotonus anfangs schnell zu; die Zunahme beginnt aber gegen 10″ nach der Schliessung des polarisierenden Stromes sich zu verlangsamen, um mit der Zeit immer langsamer zu werden, setzt sich aber während 5′-10′ fort. Auch der Katelektrotonus nimmt anfangs schnell zu und erreicht gegen 10″ nach seinem Entstehen das Maximum, dann aber fängt an abzunehmen. Diese Abnahme wird mit der Zeit immer geringer, setzt sich aber während 5′-10′ fort. Was die Stärke der elektrotonischen Ströme betrifft, so wurde diese an verschiedenen Zwischenstrecken gemessen. Die Stärke nimmt mit der Länge der Zwischenstrecke augenscheinlich exponentiell ab. Verf. rechnete die Potentialverteilung längs der extrapolaren Strecke aus den gewonnenen Zahlenwerten von der Stromstärke unter der Annahme, dass der Widerstand des benutzten Nerven seiner ganzen Länge nach gleichmäßig sei, und erhielt die Formel, $P=V_1e^{-\alpha x}+V_2e^{-\beta x}$, wo P das Potential, x der Abstand vom Pol des polarisierenden Stromes, e die Basis des natürlichen Logarithmus und V_1, V_2, α und β Konstante sind. II. Einfluss der Narkotika (Aetherdampf, Aethylalkohol-Kokain) auf die elektrotonischen Ströme. Bei den Versuchen soll man den Einfluss der Narkose auf den elektrischen Widerstand des Nerven berücksichtigen, also wurden Potentiometrie und Galvanometrie nebeneinander ausgeführt. Um den Narkosegrad zu schätzen maß Verf. auch die Erregbarkeit des Nerven. Die Erregbarkeit und die elekrotonischen Ströme wurden ganz unabhängig voneinander durch die Narkose beeinflusst. Während des ganzen Experimentes wurde die elektrische Isolierung besonders beachtet. K. Inoue.

369. **On the Classification of Japanese *Sphaerium*.** (Japanese with English résumé.) Syuiti MORI. [Venus, 4, No. 3 (1933), 149-158, 14 figs.] — The synonymy of ***Musculium*** with *Sphaerium* is discussed. 4 Japanese species of *Sphaerium* are described, of which *S. miyadii* is new and a new subspecies, *S. japonicum biwaense*, is proposed for *S. inutile* Pilsbry. A. Ichikawa.

370. **Description of a New *Dentalium* from Southern Japan.** Yanosuke OTUKA.

[Venus, **4,** No. 3 (1933), 159–161, 6 figs.] — *Dentalium (Antalis) marukawai* n. sp.
A. Ichikawa.

371. A History of Japanese Conchology. 13. (Japanese.) Tajima KANAMARU. [Venus, **4,** No. 3 (1933), 161–167, 1 fig.]

372. Molluscan Fauna of Fukui Prefecture. (Japanese.) Tokubei KURODA. [Venus, **4,** No. 3 (1933), 171–181.]

373. Measurements of Shells of *Turbo cornutus* from Shimané Prefecture. (Japanese.) S. TAKAGI. [Venus, **4,** No. 3 (1933), 181–183, 4 figs.]

374. A List of Genera of Japanese Mollusca. 3. (Japanese.) Tokubei KURODA. [Venus, **4,** No. 3 (1933), 184–191.]

375. Description of *Glycymeris imperialis* n. sp. collected by His Majesty the Emperor of Japan. (Japanese with English résumé.) Tokubei KURODA. [Venus, **4,** No. 4 (1934), 201–203, 1 pl.]

376. On Some Rare Shells from Sagami Bay collected by His Majesty the Emperor of Japan. (Japanese.) Tokubei KURODA. [Venus, **4,** No. 4 (1934), 204–208.]

377. On the Possibility of Self-fertilization and Longevity of Spermatozoa in the Receptaculum Seminis of a Land Snail, *Bradybaena similaris stimpsoni* (Pfeiffer). (Japanese with English résumé.) Kahei IKEDA and Shigeo EMURA. [Venus, **4,** No. 4 (1934), 208–224, 1 fig.] — Virgin snails reared in strict isolation show a low degree of self-fertilization, mainly owing to the difficulty of migration of the sperm from the ovotestis to the receptaculum seminis. Breeding experiments show that oviposition is directly influenced by the amount of spermatozoa in the receptaculum seminis, or the number of previous copulations. Crosses (7) were made between unbanded snails and homozygotic or heterozygotic banded forms. The crossing experiments indicate that the spermatozoa in the receptaculum seminis retain their life and fertilizing ability for at least 16 months.
A. Ichikawa.

378. On *Polinices (Neverita) didyma* (Bolten). (Japanese.) Isao TAKI. [Venus, **4,** No. 4 (1934), 224–234, 4 figs.] — Nomenclatorial notes, morphology, economic status, and distribution.
A. Ichikawa.

379. On the Application of $a=kb^{\prime}$ in expressing the Growth Relation of the Embryonic Shells of *Semisulcospira libertina*. (Japanese.) Toshio OHUYE. [Venus, **4,** No. 4 (1934), 234–239, 1 fig.] — The embryonic shells are measured and the applicability of $a=kb^{\prime}$ in expressing the growth relation between the width and length of the shells is discussed.
A. Ichikawa.

380. On the Genitalia of *Euhadra sadoensis* (Pilsbry et Hirase). A Preliminary. (On the Functional Morphology of the Reproductive Organs of the Japanese Pulmonata. II.) (Japanese.) Shigeo EMURA. [Venus, **4,** No. 4 (1934), 240–243, 7 figs] — Anatomical notes.
A. Ichikawa.

381. A History of Japanese Conchology. 14. (Japanese.) Tajima KANAMARU. [Venus, **4,** No. 4 (1934), 244–247, 2 figs.]

382. On the Genus *Bulimus* from Korea and Manchuria. (Japanese.) Noboru SHIBA. [Venus, **4,** No. 4 (1934), 247–257, 1 map, 2 figs.] — *B.* (*Parafossarulus*) *striatulus* (Benson) and B. (*Gabbia*) *kiusiuensis* (Hirase) occur in Korea, and the latter is further distributed in Manchuria. Specimens of *B.* (*P.*) *striatulus* from different localities in Korea show some variations.
A. Ichikawa.

383. A List of Genera of Japanese Mullusca. 4. (Japanese.) Tokubei KURODA. [Venus, 4, No. 4 (1934), 258-265.]

384. Recent Mollusca from Onahama, Hukusima-Ken. (Japanese.) Sitihei NOMURA and Haruhiko TUNODA. [Saitô Hô-on Kw. Hak. Zihô Tok. (1933), 1-19.] — 91 species of Pelecypoda, 101 of Gastropoda, 5 of Amphineura, 9 of freshwater and 3 of land mollusks are listed. Both northern forms, such as *Pecten swiftii* Bernardi, *Priene oregonensis* (Redfield), and southern forms, such as *Paphia schnelliana* (Dunker), *Dosinia bilunulata* Gray, *Tellina ojiensis* Tokunaga, several species of *Cypraea*, *Cymatium tenuiliratum* (Lischke), *Charonia lampas* (Linnaeus), and *Phalium strigatum* (Gmelin) are represented. S. Ohfuchi.

385. Recent Mollusca from Matusima, Miyagi-Ken. (Japanese.) Sitihei NOMURA and Kotora HATAI. [Saitô Hô-on Kw. Hak. Zihô Tok. (1932), 1-16.] — 84 species of Pelecypoda, 2 of Scaphopoda, and 161 of Gastropoda. The majority are already known from northern Japan, while a few are known only from central Japan or further south. A number of small forms have their type locality in the Upper Musasino of the Kwantô region; a few seem to be as yet undescribed. The work is still in progress. S. Ohfuchi.

386. Recent Mollusca from Mutu-Wan, Aomori-Ken. (Japanese.) Sitihei NOMURA and Kotora HATAI. [Saitô Hô-on Kw. Hak. Zihô Tok. (1932), 1-13.] — 85 species of Pelecypoda, 3 of Scaphopoda and 65 of Gastropoda. The fauna is decidedly a mixed one and contains forms found in western or central Japan. The occurrence of *Arca arabica* Philippi, *Arca symmetrica* Reeve, *Kellia japonica* Pilsbry, *Dosinia angulosa* Philippi, *Clemtentia vahteleti* Mabille, *Tellina consanguinea* Sowerby, *Macoma rhomboides* (Quoy et Gaimard), *Strombus japonicus* Reeve, *Natica adamsiana* Dunker, and *Nassarius alvescens* (Dunker) is interesting as extending the limit of their geographical distribution.

S. Ohfuchi.

387. Ecological Observations on *Rhacophorus schlegelii* var. *arborea* (Okada and Kawano) of Mount Hakkôda, Aomori Prefecture. (Japanese.) Kanzo WADA. [Report of the Saitô Hô-on Kwai, Monograph No. 10 (1931), p. 1-168, 64 pls.] — Species found, distribution, habitat, breeding, development, tadpoles, growth after metamorphosis, concluding remarks, appendix (vertebrates of Mount Hakkôda). S. Ohfuchi.

388. Benthic Animals of the Lakes of Etorohu-Sima. (Japanese.) Denzaburo MIYADI. [Jap. Jour. Limnol., 3, No. 2 (1933), 41-45, 2 tabs.]

389. Studies on the Food of *Salvelinus malma* Walbaum in Summer. (Japanese.) Shinroku NISHIO. [Jap. Jour. Limnol., 3, No. 3 (1934), 62-70, 1 fig., 2 tabs.] — From the stomach contents of 289 specimens of *Salvelinus malma* from a stream near Sôunkyô, Isikarino-Kuni, Hokkaikô, and some other localities, it appears that this fish seems to eat any small animals accessible to it. In the mountain streams its food consists chiefly of insects, larvae and adults of such aquatic insects as Trichoptera, Diptera and Ephemeroptera making up 85% of the total. It devours both eggs and young of other salmonoid fishes. In the sea it feeds on various small fishes, mysids, etc. D. Miyadi.

390. Copepoda of Kunasiri-Sima. (Japanese.) Kenzo KIKUCHI. [Jap. Jour. Limnol., 3, No. 4 (1934), 109-110, 1 fig.] — The following species of Copepoda and Rotatoria were identified in the plankton samples collected by A. Tanaka during September 2-12, 1933, in the lakes of Kunasiri-Sima of the South Kurile Islands. Copepoda: *Eurytemora affinis* (Poppe) and *Ergasilus* sp. (copepodid), the former also recorded from Hokkaidô and Etorohu-Sima, and the latter from Etorohu-Sima. The copepod fauna of this island seems to be more closely related to that of Hokkaidô than to that of the North Kuriles. Rotatoria: *Anuraea cochlearis* Gosse, *Ploesoma truncatum* Levander, *Asplanchna priodonta* Gosse, *Brachionus urceolaris* O. F. Müller, the last mentioned being very abundant in Itibisinai-ko with very acid water (pH 2.8).

D. Miyadi.

391. Formicid found in the Bottom-mud of Lake Itibisinai, Kunasiri. (Japanese.) Cho TERANISHI. [Jap. Jour. Limnol., **3**, No. 4 (1934), 111.] — In the bottom samples collected by A. Tanaka in Itibisinai-ko (Sept. 10, 1933) were found 6 winged females of *Myrmica lobicornis* Nylander var. *jessensis* Forel, presumably drowned during nuptial flight not long before. This is the first record of this species from the Kurile Islands, although previously known from Karahuto, Hokkaidô and North Honsyû. D. Miyadi.

392. Plankton of the Lakes of the Island of Kunasiri. (Japanese.) Masuzo UÉNO. [Jap. Jour. Limnol., **3**, No. 4 (1934), 129–133, 2 figs., 2 tabs.] — The following species have been found in the plankton samples collected by A. Tanaka from four lakes of Kunasiri-Sima (South Kurile) during September 2–12, 1933. *Asplanchna priodonta* Gosse, *Polyarthra platyptera* Ehrenberg, *Triarthra longiseta* Ehrb. (limnetica), *Euchlanis dilatata* Ehrenberg, *Monostyla lunaris* Ehrenberg, *Synchaeta* sp., *Pedalia mira* (Hudson), *Brachionus urceolaris* O. F. Müller, *Anuraea cochlearis* Gosse, *Ploesoma truncatum* Levander, *Bosmina longirostris* O. F. Müller, *Bosmina coregoni* Baird, *Graptoleberis testudinaria* (Fischer), *Chydorus gibbus* Lilljeborg, *Leptodora kindtii* (Focke), *Eurytemora affinis* Poppe, *Ergasilus* sp. (copepodid), copepod nauplii. Most of these species are cosmopolitan and more intimately related to those of Hokkaidô than to those of the North Kuriles. *Brachionus urceolaris* from Itibisinai-ko was reddish orange in color. The occurrence of *Leptodora kindtii* in Nihon'iwa-taiko with an area of only 0.01 sq. km. is notable because in Honsyû it is found only in large lakes. D. Miyadi.

393. On the Pathogenicity of *Entamoeba histolytica* cultivated for Five Years. (Japanese.) Naonori KUWAHARA and Katsuchiyo OGURA. [Tokyo Iji Shsh, No. 2874 (1934), 929–931, 1 fig.] — *Entamoeba histolytica* grown in Tanabe-Chiba's medium was still able to produce dysentery in kittens for 202 days, 2 years and 5 years. N. Ishii.

394. Study on the Trematode from the Intermediate Host *Palaemon longipes*. (Japanese.) Teibun KUROKAWA. [Tokyo Iji Shsh, No. 2881 (1934), 1356–1361.] – The author could parasitize the bladder of *Pseudbagrus aurantiacus*, *Parasilurus asotus*, *Diemyctylus pyrrhogaster* and *Megalobatrachus japonicus* with the encysted and unencysted larvae of *Phyllodistomum folium* from the gonads of *Palaemon longipes*

395. On the Nutritive Substances of *Ancylostoma caninum* and Histological Changes caused by it in the Intestine. (Japanese.) Akira YAMADA and Kazuwo INOUE. [Manshu Ig. Z., **20**, No. 20 (1934), 485–494, 2 figs.] — The intestinal epithelial cells taken into the mouth by *Ancylostoma caninum* are digested and liquefied, as may be seen in the mouth and intestine of the worm. The red and white blood cells are discharged unchanged from the intestine of the worm. The hemorrhage and loss of the intestinal tissues of the host are mechanically caused by the biting of the worm, but the atrophy of the glands and cell infiltrations chemically by the toxin of the worm. N. Ishii.

396. Statistical Observations on the Intestinal Amoeba and its Morphological and Biological Study. (Japanese.) Moju HIRAYAMA. [Fukuoka Ikw. Daig. Z., **27**, No. 4 (1934), 719–832, 4 figs.] — Fecal examinations of 225 subjects in Fukuoka Prefecture, six times for each, gave the following frequencies: *Entamoeba dysenteriae* 6.7%, *Entamoeba coli* 18.7%, *Endolimax nana* 36.9%, *Iodamoeba bütschlii* 6.7% and *Dientamoeba fragilis* 12.0%. N. Ishii.

397. On the Encysted Cercariae in *Pseudorasbora parva*. (Japanese.) Tsuneji HASEGAWA. [Okayama Ig. Z., **46**, No. 6 (1934), 1397–1434, 44 figs.] — 15 species of metacercariae were found encysted in *Pseudorasbora parva* in Okayama Prefecture: viz. *Clonorchis sinensis*, *Metorchis orientalis*, *Stamnosoma armatum*, *Stamnosoma* sp., *Echinochasmus perfoliatus*, *Echinochasmus japonicus*, *Exorchis oviformis*, *Exorchis major*, *Cyathocotyle* sp. a, b, c, *Metagonimus takahashii* and three undetermined ones. N. Ishii.

398. Revision der japanischen Scoliiden mit Beschreibung der neuen Arten und Formen. Toichi UCHIDA. [Jour. Fac. Agr., Hokkaido Imp. Univ., **32**, (1933), pt. 6, 229–262, 2 pls.] — Systematische Uebersicht über die Scoliden Japans, mit Beschreibung der 3 neuen Arten

und 13 neuen Formen. Neue Arten: *Scolia (Scolia) minowai, Campsomeris mojiensis* und *C. sakaguchii.* Neue Formen: *Scolia (Liacos) erythrosoma* f. *chosensis, S. (Carinoscolia) vittifrons* f. *nipponensis, S. (Scolia) 4-pustulata* f. *6-pustulata, S. oculata* f. *satoi, S. ventralis* f. *nigriventris, S. ventralis* f. *itoi, S. clypeata* f. *horaiensis, S. clypeata* f. *sonani, S. watanabei* f. *shirakii, Campsomeris schulthessi* f. *betremi, C. schulthessi* f. *shiotsuensis, C. palauensis* f. *uchiyamai* und *C. prismatica* f. *shibatai.* S. Kuwayama.

399. Beitrag zur Kenntnis der Cerambyciden des Japanischen Reichs. Masaki MATSUSHITA. [Jour. Fac. Agr., Hokkaido Imp. Univ., **34** (1933), pt. 2, 157–445+(i–x), 5 pls.] - Verf. beschreibt 258 Gattungen, 684 Arten, 9 Unterarten und 30 Varietäten, von denen 16 Gattungen, 2 Untergattungen, 94 Arten, 2 Unterarten, 11 Varietäten und 6 Aberrationen systematisch neu sind; auch Ergebnis über das zoogeographische Verhältnis japanischer Cerambyciden, Nachträge und Verbesserungen sind gegeben. Neue Gattungen: *Etorofus* (Genotypus: *E. variicornis* Matsushita), *Lautitia* (Genotypus: *L. elegantula* Matsushita), *Paraopsimus* (Genotypus: *P. orientalis* Matsushita), *Kamuia* (Genotypus: *K. bimaculata* Matsushita), *Niphocerambyx* (Genotypus: *Neocerambyx chrysothrix* Bates), *Schwarzerium* (Genotypus: *Aphrodisium? semivelutinum* Schwarzer), *Neosalpinia* (Genotypus: *N. lepturoides* Matsushita), *Obriomorpha* (Genotypus; *Iphra? apicale* Schwarzer), *Mesoereis* (Genotypus: *M. koshunensis* Matsushita), *Jezohammus* (Genotypus: *J. nubilus* Matsushita), *Kamikiria* (Genotypus: *K. plagiata* Matsushita), *Paraphidora* (Genotypus: *P. fuscoflava* Matsushita), *Doius* (Genotypus: *D. rufescens* Matsushita), *Niijimaia* (Genotypus: *N. bifasciana* Matsushita), *Neopraolia* (Genotypus: *N. delicata* Matsushita) und *Penthides* (Genotypus: *P. flavus* Matsushita). Neue Untergattungen: *Rhondiomorpha* (Genotypus: *Rhandia formosa* Matsushita), *Konoa* (*Nivellia valida* Matsushita). Neue Tribus: *Xenicotelini.* Neue Arten: *Microrhabdium jozanense, Artelida asiatica, Gaurotes atripennis, Pidonia signata, Pseudopidonia miwai, P. nipponensis, P. ohbayashii, P. oculata, P. quadrimaculata, P. rufoscutellata, P. ruficollis, P. tokugoana, Nivellia (Konoa) valida, Leptura (Anoplodermorpha) formosana, L. (A.) pullata, L.* (s. str.) *kongoensis, Etorofus variicornis, Strangalia* (s. str.) *horishana, S.* (s. str.) *latipennis, S. (Strangalina) hakonensis, S. (S.) koyaensis, S. (S.) ohbayashii, Thranius infernalis, Lautitia elegantula, Molorchus simplexus, Microdebilissa testacea, Pyrocalymma hozanensis, Paraopsimus orientalis, Kamuia bimaculata, Mallambyx fasciatus, Zegriades maculicollis, Chelidonium sauteri, Xylotrechus cinerascens, X. generosus, Clytus lautus, C. sachalinensis, C. viridescens, Perissus fulvopictus, P. niijimai, Chlorophorus dubius, C. parvus, C. spadiceus, C. taiwanus, Demonax sauteri, Anaglyptus meridionalis, Allotraeus baibaranus, Ceresium elongatum, C. sakaiense, Neosalpinia lepturoides, Stenhomelus baibarensis, S. taiwanus, Psacothea tenebrosa, Dihammus flaxini, D. maculihumerus, Orsidis bimaculatus, Cyriocrates albopictus, Cycos rugosus, Mesoereis koshunensis, M. obscurus, Mesosa kuntzeni, Jezohammus nubilus, Kamikiria plagiata, Rhodopis okinawensis, Dorcaschema albatum, Pterolophia loochooana, Pterolophia subangusta, Desisa takasagoana, Cornallis costata, Stimura formosana, Rhopaloscelis sapporensis, Paraphidola fuscoflava, Eupogonius rufipennis, Oplosia jezoensis, Sydonia costata, Doius rufescens, D. meridianus, Pothyne albolineata, P. liturata, P. taihokensis, Niijimaia bifasciana, Ostedes subfasciata, Rondibilis mushensis, Exocentrus galloisi, E. leiopodinus, Cagosima jezoana, Neopraolia delicata, Glenea horishana, G. stolata* (Matsumura et Matsushita), *Oberea maculithorax, O. signaticornis, O. taiwana, Linda annulicornis, Stenostola jezoana* und *Penthides flavus.* Neue Unterarten, Variäteten und Aberrationen: *Megopis (Aegosoma) buckleyi formosana, Toxotinus reini* var. *nikkoensis, Evodinus bifasciatus* var. *japonicus, Omphalodera puziloi* var. *testacea, Pseudopidonia insuturata* ab. *reducta, P. ohbayashii* ab. *shiranensis, Etorofus variicornis* var. *niger, E. variicornis* var. *nemurensis, Strangalia arcuata* ab. *nigronotata, S. duodecimguttata* ab. *conjuncta, S. duodecimguttata* ab. *x-litera, S. regalis* ab. *awana, Asemum striatum japonicum, Semanotus chinensis* var. *latifasciatus, Anaglyptus nipponensis* var. *anticenigris, Sternoplistes temmincki* var. *kiotensis, Mesoereis koshunensis* var. *kikuchii, Acanthocinus cerinulatus* var. *sachalinensis* und *Oberea maculithorax* var. *pulla.* S. Kuwayama.

400. Supplementary Notes on the Platypodidae of Formosa IV. Jozo MURAYAMA. [Jour. Fac. Agr., Hokkaido Imp. Univ., **35,** pt. 3 (1934), 133–149.] — Notes on 18 species including descriptions of 3 new ones, *Platypus arisannensis* Murayama, *Crossotarsus emancipatus* Murayama and *Diapus truncatus* Niijima et Murayama. Appended is a key to the species of *Platypus, Crossotarsus* and *Diapus.* S. Kuwayama.

401. A List of the Injurious Insects of the Agricultural Plants on Southern Saghalien. Matsuji HORI. [Bull. Saghalien Centr. Exp. Sta., **8**, Ser. I, No. 2 (1934), 1-54.] — Seventy six species beloging to 29 families and 7 orders are listed. S. Kuwayama.

402. New Species of Butterflies from Japan. Shonen MATSUMURA. [Ins. Mats., **8** (1934), No. 3, 105-106, 2 figs.] — *Halpe aokii* and *Erynnus comma* f. *sachalinensis* are newly described. S. Kuwayama.

403. Beitäge zur Systematik der Tribus Paniscini Japans (Hym. Ichneum. Tryphoninae). Toichi UCHIDA. [Ins. Mats., **8** (1934), No. 3, 107-115, 1 Fig.] — Uebersicht der 22 *Paniscus*-Arten unter den 3 Untergattungen, mit Beschreibung von *P.* (*Parabates*) *inaequalis* n. sp., *P.* (*Parabates*) *virgatus* f. *odaiensis* n., *P. virgatus* f. *nipponensis* n. und *P.* (*Parabates*) *cristatus* f. *yamatoensis* n S. Kuwayama.

404. H. Sauter's Formosa Ausbeute: Mordellidae. Hiromichi KÔNO. [Ins. Mats., **8** (1934), No. 3, 116-118.] — Notizen über 5 Arten. Neue Arten: *Glipa alboscutellata*, *Mordellistena taiwana* und *M. horni.* S. Kuwayama.

405. On Some Species of Braconidae from Formosa and the Philippines in the Deutsches Entomologisches Museum. Chihisa WATANABE. [Ins. Mats., **8** (1934), No. 3, 119-123, 2 figs.] — Of 8 species enumerated under 3 subfamilies, *Rhaconotus formosanus*, *Laccagathis* (n. g.) *formosana*, *L. japonica* and *L. mindanaensis* are described as new. S. Kuwayama.

406. Die Dryopiden aus Japan. Hiromichi KÔNO. [Ins. Mats., 8 (1934), No. 3, 124-128.] — Beschrieben sind 9 Arten unter 8 Gattungen, darunter 2 Gattungen und 3 Arten neu. Neue Gattungen: *Betelmis* Matsumura et Kôno (Genotypus: *B. japonicus*) und *Awadoronus* (Genotypus: *A. awanus*). Neue Arten: *Stenelmis flavovittatus*, *Grouvelleus marginatus* und *Awadoronus awanus.* S. Kuwayama.

407. Zwei Neue *Byrrhus*-Arten (Col.). Hiromichi KÔNO. [Ins. Mats., **8** (1934), No. 3, 129-131, 3 figs.] — *B. daisetsusanus* und *B. ekashi.* S. Kuwayama.

408. Notes on Braconidae of Japan IV. *Apanteles* (First Supplement). Chihisa WATANABE. [Ins. Mats., **8** (1934), No. 3, 132-143, 1 fig.] — Of 13 species the following are newly described: *Apanteles vallatae*, *A. neptisis*, *A. kamiyai*, *A. amphipyrae*, *A. kawadai*, *A. bistonis*, *A. aphae*, *A. conopiae* and *A. uchidai.* S. Kuwayama.

409. On the Tenebrionidae from Saghalien. Koichi TAMANUKI. [Ins. Mats., **8** (1934), No. 3, 144-146] - Record of 15 species. S. Kuwayama.

410. Fauna of the Thysanoptera in Japan. Part IV. Masato ISHIDA. [Ins. Mats., **8** (1934), No. 3, 147-151.] — Notes on the genus *Ecacanthothrips*, with description of *E. matsumurai* n. sp. S. Kuwayama.

411. Two New Genera, Four New Species and One New Form of Notodontidae from Japan and Formosa. Shonen MATSUMURA. [Ins. Mats., **8** (1934), No. 3, 152-155, 5 figs.] — New genera: *Nagandopsis* (genotype *N. kawachiensis*) and *Marushachia* (genotype *M. rotundata*). New species: *Nagandopsis kawachiensis*, *Marushachia rotundata*, *Hyperaeschra hikawana* and *Lophopteryx teshionis*. New form: *Lophopteryx camelina* f. *sachalinensis*. S. Kuwayama.

412. Die japanischen Hylobiinen (Col. Curc.). Hiromichi KÔNO. [Jour. Fac. Agr., Hokkaido Imp. Univ., **33**, pt. 3 (1934), 223-248, 2 Taf.] — Beschreibungen von 37 Arten und 4 Unterarten, unter 11 Gattungen, von denen 4 Gattungen, 9 Arten und 2 Unterarten neu sind. Neue Gattungen: *Poiyaunbus* (Genotypus: *Hylobius gebleri* Boheman), *Okikuruminus* (Genotypus: *Curculio roelofsi* Harold), *Nipponiphades* (Genotypus: *Scaphostetus foveolatus* Hustache), *Himeni-*

phades (Genotypus: *Himeniphades bipunctatus* Kôno). Neue Arten: *Hylobius adachii, H. montanus, H. koreanus, H. shikokuensis, H. yakui, H. galloisi, H. gigas, H. okinawanus* und *Himeniphades bipunctatus*. Neue Unterarten: *Hylobius pinastri karafutonis* und *Okikuruminus roelofsi sachalinensis*.
S. Kuwayama.

413. Distribution of the Families and Genera of Butterflies with the Special Reference to those of the Japan-Empire. Shonen MATSUMURA. [Trans. Sapporo Nat. Hist. Soc., **13**, pt. 3 (1934), 256-265.] S. Kuwayama.

414. On the Life-history of Two Species of Leptocerid Caddis-flies Injurious to the Rice-plant. Satoru KUWAYAMA. [Trans. Sapporo Nat. Hist. Soc., **13**, pt. 3 (1934), 266-274, 4 figs.] - Descriptions of mature and immature stages of *Setodes argentata* Matsumura and *Oecetis nigropunctata* Ulmer and notes on the life history and habits of these species. The life histories of both are very similar and the larvae always live in the same rice-field. There is only one generation in a year and the larvae overwinter. They leave their winter quarters early in the spring, commence to feed ravenously on the young shoots of rice-plants, and may be found in the middle of June. The adults begin to appear from the end of June to August and disappear by the middle of September. During this season adults may occur literally by thousands among the bushes and trees along the infested rice-fields; they are easily attracted to artificial light in the evening. The eggs are deposited in masses on the surface of water from early July to late August, each mass being a sphere of jelly. Hatching takes place in 1-2 weeks, and the aquatic larvae feed on weeds or decayed plant debris, and grow nearly to half as long as the adults. Usually these caddis-worms attack only rice-plants directly sown in lowland fields, the nursery plants as well as those transplanted from the nurseries being immune from them.
Author.

415. Eine neue Gattung und eine neue Art der Unterfamilie Metopiinae. (Hym. Ichneum.) Toichi UCHIDA. [Trans. Sapporo Nat. Hist. Soc., **13**, pt. 3 (1934), 275-277, 4 Fig.] — Beschreibung von *Cerataspis clavata* gen. et sp. nov. S. Kuwayama.

416. Die Cryptoderminen Japans (Col. Curc.). Hiromichi KÔNO. [Trans. Sapporo Nat. Hist. Soc., **13**, pt. 3 (1934), 278-279, 1 Fig.] — Notizen über *Cryptoderma fortunei* Waterhouse und *C. formosense* n. sp. S. Kuwayama.

417. On Evaniidae and Gasteruptionidae from Japan (Hymenoptera). Chihisa WATANABE. [Trans. Sapporo Nat. Hist. Soc., **13**, pt. 3 (1934), 280-286, 2 figs.] — One evaniid and four gasteruptionids. The new species are *Gasteruption oshimensis, G. ogasawarensis* (Matsumura et Watanabe), and *Trichofoenus breviterebrae*. S. Kuwayama.

418. Review of the Notodontid-moths in the "6000 Illustrated Insects of the Japan-Empire". Shonen MATSUMURA. [Ins. Mats., **8**, No. 4 (1934), 157-181.] — A revised list of 195 species referable to 101 genera. New genus: *Torigea* (genotype *Pydna plumosa* Butler). New species: *Phalera formosicola, P. muku*, and *Stauropus usuguronis*.
S. Kuwayama.

419. H. Sauter's Formosa-Collection: Braconidae. Chihisa WATANABE. [Ins. Mats., **8**, No. 4 (1934), 182-205, 6 figs.] — A list of 51 species under 6 subfamilies, including 11 new species and 12 hitherto unknown from Formosa. New species: *Merinotus taiwanus, Bracon kuro, B. koshunensis, Coeloreuteus formosanus, Spathiohormius sauteri, Eucorystes formosanus, Gyroneuron testaceator, Microdus sauteri, M. albifasciatus, M. formosanus*, and *Cenocoelius koshunensis*. S. Kuwayama.

420. On the Embryological Basis of Vertebrate Mortality Rates. Masao KATAYAMA. [Proc. Imp. Acad., **10** (1934), No. 6, 384-387, 2 figs., 3 pls.] — Statistical study of the mortality of mammals and birds based on data obtained from the London Zoological Society's Gardens. When the biologically classifiable mortality is grouped under nine organ systems, the respiratory and digestive systems are responsible for death in the majority of mammals and

birds as in man, the lethal breakdown of entodermal organ systems topping the list with 65.7% in mammals and 79.7% in birds. On the other hand, 7.3% of deaths in mammals and 2.0% in birds can be regarded as due to breakdown of ectodermal organ system. The remaining 27.0% of mortality in mammals and 18.3% in birds result from failure of mesodermic organs.
Author.

421. On the External and Internal Characters of the Bony Fishes of the Genus *Vegetichthys*, with a Description of One New Species. Masao KATAYMA. [Proc. Imp. Acad., **10** (1934), No. 7, 435–438, 5 figs.] — After a careful examination of the external and internal characters the author emends the genus *Vegetichthys* and describes *V. caeruleus* n. sp., from Hatizyô Is., Prov. Idu, closely related to *V. xanthurus*, but differing from it in the following points: dorsal spine strong; pored scales few on lateral line; pyloric caeca 7 (in *V. xanthurus* 5); behind ethmoid a narrow flattish area of frontals; color dark blue, not yellow, on the dorsal side of body.
Author.

422. Sur une nouvelle espèce du genre *Paracercorchis* (trématode) parasite de la tortue d'eau douce *Clemmys japonica*. Tamao FUKUI et Tôji OGATA. [Sci. Rep. Tokyo Bunr. Daig., sect. B, **1**, No. 19 (1934), 203–211.] — La nouvelle espèce, *P. megacotyle*, ressemble beaucoup au *P. pellucidus*, mais elle s'en distingue facilement par les caractères suivants: 1) chez *P. megacotyle* les testicules sont massifs à marges entières, tandis que chez *P. pellucidus* les organes ont les entailles dans leur partie postérieure; 2) chez *P. megacotyle*, l'ouverture génitale est située immédiatement en avant de la ventouse ventrale, mais chez *P. pellucidus* elle est un peu en arrière de l'acetabulum; 3) chez *P. megacotyle* l'œsophage est long et le pharynx petit, tandis que *P. pellucidus* a l'œsophage court et le prépharynx plus ou moin long; 4) chez *P. megacotyle* la ventouse ventrale est, contrairement au cas de *P. pellucidus*, plus grande que la ventouse orale.
Tohru Uchida.

423. *Telorchis konoi* n. sp. (trématode) parasite de la tortue d'eau douce *Geoclemmys reevesi*. Tôji OGATA. [Sci. Rep. Tokyo Bunr. Daig., sect. B, **1**, No. 20 (1934), 213–219.] — Cette espèce est caracterisée principalement par ce que son ovaire est situé très loin postérieurement du corps; elle se rencontre à peu près au niveau de milieu du corps. À ce point elle ressemble beaucoup plus au *T. attenuatus*, mais elle diffère surtout de ce dernier par la dimension du corps.
Tohru Uchida.

424. Contribution to the Study of Japanese *Arenicola*. Part 1. Notes on the Habits and Distribution of *Arenicola* in Japan. Keizo TAKAHASHI. [Sci. Rep. Tokyo Bunr. Daig., sect. B, **1**, No. 24 (1934), 271–279.] — Notes on some ecological observations and distribution of *A. cristata* and *A. claparedii*.
Tohru Uchida.

425. Brachyura from the Coast of Kyushu, Japan. Tune SAKAI. [Sci. Rep. Tokyo Bunr. Daig., sect. B, **1**, No. 25 (1934), 281–330.] — A list of Brachyura from Kyushu, with descriptions of some known species and the following five new ones: *Philyra kanekoi* (resembling *P. carinata* but distinguishable by its depressed broader rhomboidal carapace), *Maja nipponensis* (different from *M. japonica* in form of carapace, chelipeds and legs), *Pilumnus heterodon* (similar to *P. penicillatus* in the shape of the male first abdominal appendages and in general aspect of carapace), *Heteroplax nagasakiensis* (distinguishable from *H. transversa* by the oblique supra-orbital ridge and the granulation on the hepatic region near its lateral teeth), and *Paracleistostoma japonicum* (resembling *P. cristatum* in male abdomen and in anterior abdominal appendages but differing from it in the presence of three antero-lateral protuberances).
Tohru Uchida.

426. Bryozoa Fauna in the Vicinity of the Shimoda Marine Biological Station. Yaichiro OKADA. [Sci. Rep. Tokyo Bunr. Daig., sect. B, **2**, No. 26 (1934), 1-202, 2 pls.] — Description of 22 species of cheilostomatous Bryozoa; *Iodictyum shimodai* is new.
Tohru Uchida.

427. The Aquatic Insects at Nikko. Yaichiro OKADA and Isamu HORASAWA. [Sci. Rep. Tokyo Bunr. Daig., sect. B, 2, No. 27 (1934), 21-27.] — Ecological notes on aquatic insects with remarks on their distribution in this district; both lowland and typical mountain forms are found. Tohru Uchida.

428. A List of Bird Skins belonging to the Order of Accipitres kept in the University Museum of Natural History in Sapporo. Marquis Yoshimaro YAMASHINA and Kôzô MUKASA. [Trans. Sapporo Nat. Hist. Soc., 8, pt. 3 (1934), 287-297.] — 125 specimens referable to 2 families and 26 species. Tohru Uchida.

429. Plankton of the Lakes of the Island of Etorofu (Iturup). Masuzo UÉNO. [Trans. Sapporo Nat. Hist. Soc., 8, pt 3 (1934), 298-312.] — Observations on 20 lakes, one of volcanic and the others of marine origin. Of 30 species of zooplankton, rotifers were richest in species and Cladocera came next; no eulimnetic protozoans were found. The phytoplankton was richest in diatoms, of which there were 20 species. The plankton fauna of Etorofu lakes are more nearly allied to that of Hokkaido lakes than to those of the North Kuriles. It is noteworthy that a marine relict copepod, *Sinocalanus tenellus*, occurs in three lakes of marine origin. The number of individuals of each species at depth of 10-20 m was about half as large as at 0-10 m, and no plankton was found below 17 m. The composition of plankton was highly variable in different lakes. In those with large numbers of crustaceans, phytoplankton was quite scarce, while in those with abundant phytoplankton many rotifers were found. In 10 coast-lakes, in which *Chironomus plumosus* larvae were characteristic bottom inhabitants, the phytoplankton usually appeared and vigorous water-bloom developed. Tohru Uchida.

430. On the Partial Albino of the Japanese Mink found in Hokkaido. Tetsuo INUKAI. [Trans. Sapporo Nat. Hist. Soc., 8, pt. 3 (1934), 313-316.] — The Japanese mink, *Mustela itatsi itatsi*, introduced into Hokkaido quite accidentally about 60 years ago has increased year by year and covered all Hokkaido except the southeastern end. In the winter of 1933, at least 70,000 skins are said to have come on the market from Hokkaido, although protective law has been in force in some districts since December 1933 to check wild rats. The animal is usually uniformly muddy yellow above and a little paler below; the writer has however found two apparently partial albinoes. The author seems to be of opinion that these albinoes are seasonal products as in *Mustela ermina* and *M. rixosa namiyei*, which turn white in winter. Tohoru Uchida.

431. An Observation on the Sand Particles in the Gizzard of Some Small Wild Birds. Tesuo INUKAI and Shinjiro IKEDA. [Trans. Sapporo Nat. Hist. Soc., 8, pt. 3 (1934), 317-323.] — Observations on the brambling, *Fringilla montifringilla*, the Japanese finch, *Chloris sinica minor*, the Japanese cross-bill, *Loxia curvirostra japonica* and the Japanese meadow bunting, *Emberiza sicides ciopsis*. The particles were quartz, felspar, magnetite, hematite, ilmenite, augite, hornblend, limonite, chromite, pyrrhotin, clayslate, silicate. It is observed that some amount of sand grains of hard quality rather than their number and weight is necessary for seed eating birds. More sand is required, the harder the food is. Tohru Uchida.

432. On an Occurrence of *Ascaris* in the Intestine of a Bear *Ursus arctos yessensis* Lyd. Tetsuo INUKAI and Jiro YAMASHINA. [Trans. Sapporo Nat. Hist. Soc., 8, pt. 3 (1934), 324-325.] — One specimen of *Ascaris lumbricoides* was found in a bear. Tohru Uchida.

433. A Supplementary Note on Spiders from Southern Saghalien, with Descriptions of Two New Species. Saburo SAITO. [Trans. Sapporo Nat. Hist. Soc., 8, pt. 3 (1934), 326-340.] — A record of 27 species of spiders from Sakhalin, with measurements, and descriptions of 2 new species, *Theridion nivalium* (allied to *T. fordum* but distinguishable from it by the form of epigynum) and *Argiope sachalinensis*, differing from other species of *Argiope* in the peculiar form of epigynum. Tohru Uchida.

434. *Soboliphyme sahalinense* n. sp. (Nematodes), from *Martes zibelline sahaliensis*

Ogev. Kyojiro SHIMAKURA and Koichi ODAJIMA. [Trans. Sapporo Nat. Hist. Soc., **8**, pt. 3 (1934), 341–350, 1 pl.] — The second species of this nematode genus, with a detailed description.
Tohru Uchida.

435. On the Parasitism of *Heterodera schachtii* Schmidt on Beans. Katsumasa FUJITA and Osamu MIURA. [Trans. Sapporo Nat. Hist. Soc., **8**, pt. 3 (1934), 359–364.] — Inoculation experiments on various bean plants.
Tohru Uchida.

436. A List of Marine Mollusca from the Bay of Suô, Formosa. (Japanese.) Keinosuke TAN. [Trans. Nat. Hist. Soc. Formosa, **22**, No. 120 (1932), 149–152.] — 11 families of Pelecypoda comprising 24 species, and 27 families of Gastropoda comprising 118 species are enumerated, with brief faunistic notes.
Isokiti Harada.

437. A List of Turtles from the Japanese Empire. (Japanese.) Haruo TAKASHIMA. [Trans. Nat. Hist. Soc. Formosa, **22**, No. 120 (1932), 152–163.] — 1 species of Dermochelidae, 5 species of Testudinidae, 3 species of Cheloniidae and 3 species of Trionychidae are enumerated, with a key to the genera of Japanese Testudinata and brief notes on their occurrence.
Isokiti Harada.

438. On New Bats found in Micronesia (Japanese Mandate). (Japanese.) Yoshimaro YAMASHINA. [Trans. Nat. Hist. Soc. Formosa, **22**, No. 121 (1932), 240–241.] — Descriptions of three new subspecies of bats, *Emballonura semicaudata palauensis* from Palau, *Pteropus marianus paganensis* from Pagan and Almagan, and *P. marianus ulthiensis* from Ulthi.
Isokiti Harada.

439. On the Graded Differences in the Parapodia of *Nereis mictodonta* Marenzeller. (Japanese with English résumé.) S. K. TAKAHASI. [Trans. Nat. Hist. Soc. Formosa, **22**, No. 123 (1932), 496–501.] — The variations in the development and arrangement of the lamellae as well as the setae show a regular gradation depending on the distance of a segment from the head. It is therefore of particular importance that in descriptions the position of the segment selected be always specified.
Isokiti Harada.

440. On the Breeding of Formosan Birds. (Japanese.) Yasuichi HORIKAWA. [Journ. Soc. Trop. Agr., Taihoku Imp. Univ., **5**, No. 3 (1933), 291–301.] — Of 315 species (besides 28 marine species) enumerated, belonging to 20 orders, 148 species seem to breed in Formosa.
Isokiti Harada.

441. Zur Biologie des Zooplanktons im Zitugetutan (See Candidius). Studien über die Süsswasserfauna Formosas II. Isokiti HARADA. [Mem. Fac. Sci. Agr., Taihoku Imp. Univ., **7**, No. 2 (1933), 71–139, 26 Abb., 12 Tab.] — Zweck dieser Arbeit ist, die gegenwärtigen Biocoenosen der Planktonorganismen und die zur Zeit bestehenden Lebensbedingungen klar zu machen, und zugleich eine Grundlage für die Verfolgung der in der Zukunft zu erwartenden Veränderungen zu schaffen, da der See als Sammelbecken für die hydroelektrische Kraftstation ausersehen, und die Vollendung der Bauten in naher Zukunft erwartet ist. Die Untersuchungen wurden März 1929–Januar 1930 ausgeführt. Erstens sind die morphometrischen und physikalisch-chemischen Verhältnisse des Sees, und zweitens im Abschnitt über die biologischen Verhältnisse die biocoenotischen Veränderungen innerhalb des Zooplanktons im Verlauf des Untersuchungsjahres, die tägliche Schwankung der Vertikalverteilung, und zugleich auch die Schwankung der Geschlechtsverhältnisse gewisser Arten geschildert; auch als Anhang die schädigende Einwirkung eines Sturmes, welcher während der Beobachtung im August ausbrach, auf die Planktonorganismen. Im Zooplankton kamen folgende vor: *Peridinium playfairi*, freilebende Nematoden (unbestimmte Species), *Polyarthra platyptera*, *Rattulus capucinus*, *R. cylindricus*, *Diurella stylata*, *Brachionus forficula* var. *laevis*, *Schizocerca diversicornis*, *Anuraea aculeata* var. *valga*, *A. cochlearis*, *Triarthra longiseta*, *Ploesoma hudsoni*, *Pedalion mirum*, *Diaphanosoma brachyurum* var. *leuchtenbergianum*, *Bosmina longirostris*, *Macrothrix rosea*, *Chydorus sphaericus*, *Acroperus harpae*, *Alona quadrangularis*, *Pleuroxus hamulatus*, *Diaptomus birulai*, *Eucyclops euacanthus*, *E. serrulatus*, *E. prasinus candidiusi*, *Macrocyclops albidus oligolasius*, *Cyclops varicans*, *Mesocyclops*

leuckarti, *M. thermocyclopoides*, Canthocamptiden (unbestimmte Species), *Ergasilus japonicus*, *Cypria javana*, *Corethra*-Larven. Autor.

442. A Handlist of Japanese Marine Mammals. (Japanese.) Haruo TAKASHIMA. [Trans. Nat. Hist. Soc. Formosa, **23,** No. 126 & 127 (1933), 249–258.] — 35 species are enumerated and arranged according to Kishida's system, with brief notes. Isokiti Harada.

443. Einige Japanische Ostracoden. V. BREHM. [Trans. Nat. Hist. Soc. Formosa, **23,** No. 128 & 129 (1933), 297–298.] — Beschrieben sind *Notodromus monacha* Müller aus einem Teich in der Provinz Echigo, *Cypridopsis uénoi* nov. sp. und eine unbenannte Species von *Cyprinotus* aus Tümpeln in der Provinz Shinano. Isokiti Harada.

444. An Ecological Study of the Littoral Animals near the Mouth of the Tamsui River. (Japanese.) S. TAKAHASI. [Trans. Nat. Hist. Soc. Formosa, **24,** No. 130 (1934), 1–14, 1 text fig., 2 pls.] — Distribution of the littoral animals, especially Crustacea, according to the nature of the grounds. Isokiti Harada.

445. A Preliminary Report on Some peculiarly Shaped Chromosomes in Three Species of *Apodemus*. (Japanese.) Shinkichi TATEISHI. [Trans. Nat. Hist. Soc. Formosa, **24,** No. 130 (1934), 15–17.] — The chromosomes were counted in *A. agrarius ningpoënsis*, *A. semotus* and *A. speciosus speciosus*. In all three, there is in the first spermatocyte metaphase a sex chromosome, usually lying near the margin of the nuclear plate and easily distinguishable from the other autosome bivalents by its peculiar shape and staining properties, as also by its behavior. It is of XY type, and its division in the 1st spermatocyte is equational. Its reductional division occurs most likely in the 2nd spermatocyte, the first instance of the kind in mammals. Isokiti Harada.

446. On Formosan Tortoises. (Japanese.) Kenji NAKAMURA. [Trans. Nat. Hist. Soc. Formosa, **24,** No. 130 (1934), 32–39, 1 fig.] — To the three species of Testudinidae already known from Formosa, viz. *Okadia sinensis*, *Cyclemys flavomarginata* and *Clemmys mutica*, is added *Geoclemmys reevesii*. The occurrence of all the four species also in China shows the close faunistic relation of the two lands. Keys to the species of Formosan Testudinidae and of the Testudinidae and Platysternidae of China are also given. Isokiti Harada.

447. Über drei neue Arten von Chilopoden aus Formosa und den Marshall-Inseln. (Japanisch.) Yoshioki TAKAKUWA. [Trans. Nat. Hist. Soc. Formosa, **24,** No. 132 (1934), 221–225, 4 Figg.] — Beschrieben sind: *Mecistocephalus ongi* n. sp. und *Rhysida longipes* Newp. *brevicornis* n. subsp. aus Formosa; *Mecistocephalus brevisternalis* n. sp. aus den Marshall-Inseln. Isokiti Harada.

Abstracts

448. Freshwater Fossil Molluscs from the Kitamatsuura Coal-Field, Northern Kyushu, Japan. Torijiro UEJI. [Venus, 4, No. 6 (1934), 341-350, 3 pls.] — Fossil molluscs from the Oligocene of the Kitamatsuura Coal-Field, including four new species, *Hyriopsis matsuurensis* (Unionidae), *Corbicula hizenensis* (Corbiculidae), *C. nakayamana* (Corbiculidae), *Viviparus kosasanus* (Viviparidae). A. Ichikawa.

449. Notes on Fossil *Glycymeris imperialis* Kuroda. (Japanese.) Koichi SUZUKI. [Venus, 4, No. 6 (1934), 351-353, 3 figs.] A. Ichikawa.

450. On the Pallial Sinus of the Genus *Macoma*. (Japanese.) Tsuneteru OINOMIKADO. [Venus, 4, No. 6 (1934), 353-356, 11 figs., 1 pl.] — That the pallial sinus on the inner surface of the shell is a species criterion, is shown for certain species of *Macoma* by actual examples. A. Ichikawa.

451. Ecological Notes on *Tethys* (*Aplysis*) *punctata* in Formosa. (Japanese.) Sadae TAKAHASHI. [Venus, 4, No. 6 (1934), 357-360, 4 figs.] — Annual visit of this animal to the coast of Formosa, topographical distribution, food habits, copulation and egg laying. A. Ichikawa.

452. Land and Freshwater Shells of the Environs of Nikko. (Japanese.) Yaichirô OKADA. [Venus, 4, No. 6 (1934), 361-364.] A. Ichikawa.

453. Naiad Fauna of the Environs of Sapporo. (Japanese.) Kazumasa HAYASHI. [Venus, 4, No. 6 (1934), 364-368, 6 figs.] — Six species are listed and their mode of occurrence discussed. A. Ichikawa.

454. On the Optimum Temperature of the Embryonic Development of *Mactra sachalinensis*. (Japanese.) Toraichiro KINOSHITA and Yoshimi HIRANO. [Venus, 4, No. 6 (1934), 368-372, 2 tabs., 1 fig.] — Optimum temperature 16°-23°C. A. Ichikawa.

455. Miscellaneous Notes on Shells. (Japanese.) Shichihei NOMURA. [Venus, 4, No. 6 (1934), 372-374.] A. Ichikawa.

456. A History of Japanese Conchology. 15. (Japanese.) Tazima KANAMARU. [Venus, 4, No. 6 (1934), 374-379.] A. Ichikawa.

457. Notes on Some Interesting Species of Japanese Shells. 2. (Japanese.) Tokubei KURODA. [Venus, 4, No. 6 (1934), 379-388, 15 figs.] A. Ichikawa.

458. A Narrative of the Collecting Trip to Prov. Tosa (Shikoku). (Japanese.) Tazima KANAMARU and Fusao SUGITANI. [Venus, 4, No. 6 (1934), 388-399.] A. Ichikawa.

459. Description of *Ostrea nippona* n. sp., with Remarks on *Ostrea circumpicta* Pilsbry. Haruo SEKI. [Venus, 4, No. 5 (1934), 275-284, 25 figs.] — This new species has hitherto been referred to *O. multistriata* Hanley by Wakiya (1929) and to *O. circumpicta* Pilsbry by Hirase (1930). *Ostrea circumpicta* from Japanese waters is also described with several figures of shell-bearing veligers. A. Ichikawa.

460. *Lamprotula nojimensis* n. sp., a Fossil Unionid from the Kitamatsuura Coal-Field, Northern Kyushu, Japan. Torajiro UEJI. [Venus, 4, No. 5 (1934), 284-288, 8 figs.] — An Oligocene species. A. Ichikawa.

461. On the Variation of Recent and Prehistoric Specimens of *Corbicula maxima* Prime. (Japanese with English résumé.) Keinosuke TAN. [Venus, 4, No. 5 (1934), 289-302, 14 figs., 1 phot., 4 tabs.] — Living *Corbicula maxima* is known only from the small area near the mouth of the Tansui River near Taihoku, Formosa. Variations of prehistoric specimens from the shell mounds at Maruyama Park in Taihoku City are discussed and compared with those of living ones by tabulation and graphs. A. Ichikawa.

462. On the Marine Shells of Liau-tung, Manchukuo (Manchuria). (Japanese with English résumé.) Shichihei NOMURA and N. ZINBÔ. [Venus, 4, No. 5 (1934), 302-307.] — 45 forms (24 bivalves, 21 gastropods) from the coast of Liau-tung Peninsula. A. Ichikawa.

463. Conchological Notes. 5. (Japanese.) Takusuke KAWAMOTO. [Venus, 4, No. 5 (1934), 307-311.] A. Ichikawa.

464. A Guide to the Preparation of Conchological Collection. (Japanese.) Tajima KANAMARU. [Venus, 4, No. 5 (1934), 312-319.] A. Ichikawa.

465. A List of the Genera of Japanese Mollusca. 5. (Japanese.) Tokubei KURODA. [Venus, 4, No. 5 (1934), 319-330.] A. Ichikawa.

466. Female Heterogamety in the Trichopterous Insect, *Stenopsyche griseipennis* MacLachlan. Sajiro MAKINO and Hisao KICHIJÔ. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 3, No. 1 (1934), 9-16, 3 figs.] — The equatorial plate of female somatic cells shows 25 chromosomes containing a solitary sex chromosome z, while that of the spermatogonium shows 26 including zz, in other words the female is heterogametic. Chromosomes of the first and second spermatocytes and a plasmosome nucleolus found in the spermatogonial nucleus are also dealt with. A. Ichikawa.

467. The Chromosomes of the Crayfish, *Cambaroides japonicus* (de Haan). Hidejiro NIIYAMA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 3, No. 2 (1934), 41-53, 4 figs.] — Champy's solution diluted with an equal volume of distilled water and Flemming's weak solution gave the best results. The spermatogonium has 196 chromosomes, of which two are distinctly larger. The number of tetrads is 98. A. Ichikawa.

468. The Chromosomes of Some Neuropterous Insects of the Family Chrysopidae. Hisao KICHIJÔ. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, 3, No. 2 (1934), 55-65, 5 figs.] — In *Chrysopa japana*, *Ch. sapporensis*, *Ch. intima*, *Ch. kurisakiana* and *Chrysotropia japonica*, the spermatogonium has five homologous pairs and an unequal pair of x and y. *Chrysotropia japonica* is unique in that one homologous pair is V-shaped. The primary spermatocyte division of the five species is also described and figured. A. Ichikawa.

469. Habitat Notes on the Freshwater Pearl-mussel, *Margaritana margaritifera* (Linné) in Hokkaido, Japan. Kazuo KOBA. [Sci. Rep., Tokyo Bunr. Daig., Sec. B, 1, No. 16 (1934), 175-180, 4 figs, 1 pl.] — The bottom conditions which determine the topographical distribution, orientation and growth of this mussel in the Ibesibetu and Akan Rivers are dealt with. A. Ichikawa.

470. On the Range of Lethal Body Temperature of the Rat. Nobumasa YAGI and Jukichi SHIMOIZUMI. [Sci. Rep., Tokyo Bunr. Daig., Sec. B, 1, No. 22 (1934), 231-242, 11 figs.] — The range of lethal body temperature in the experimental box kept at −3°C and humidity 70–75% and that in the high temperature box were determined by the application of a copper-constantin-thermocouple to the anus of the rat (*Rattus rattus alexandrinus*); in the former it was found to be 13°C–14°C, and in the latter to be 42°C–43°C. A. Ichikawa.

471. A Study on the Development of the Tusser Worm, *Antheraea pernyi* Guér. Saburo SAITO. [Jour. Fac. Agr., Hokkaido Imp. Univ., 33, pt. 4 (1934), 249-266, 5 pls.] — A

detailed description of the structure of the egg; segmentation and blastoderm formation; the rapid multiplication of blastomeres with respect to the formation of the germ band: the surface structure of the embryo based upon the examination of the developing stages from the time the ventral plate has just differentiated from the blastoderm up to about 20 days old, when the external form of the larva is completed. A. Ichikawa.

472. House Rat as Carrier of *Entamoeba dysenteriae*. (I. Report.) On the Morphology and Cultivation of Amoebae like *Entamoeba dysenteriae* from *Mus norvegicus*. (Japanese.) Misao NAGAHANA. [Chosen Ig. Kw. Z., **24**, No. 5 (1934), 860-875, 10 figs.] — Out of the 274 *Mus norvegicus* from the city of Keijo examined by the author, he has found amoeba like *Entamoeba dysenteriae* in the intestine of three of them. Its vegetative form differs fairly from that of the human species, but is not distinguishable from it when the latter is introduced into the rat. Its cyst is entirely similar to that of the human form. No ulcerous pathological changes could be observed in the rat intestine, but in one instance the amoebae had penetrated into the intestinal tissue. In all the three instances, the amoebae could be easily cultivated in Tanabe-Chiba's medium, and their form, development and encystation are similar to those of the human form cultivated in the same medium. The resistance of these cultivated amoeba to emetine and yatren are also equal to that of the human form in the medium.
N. Ishii.

473. House Rat as Carrier of *Entamoeba dysenteriae*. (II. Report.) On the Pathogenicity of Amoebae like *Entamoeba dysenteriae* from *Mus norvegicus*. (Japanese.) Misao NAGAHANA. [Chosen Ig. Kw. Z., **24**, No. 10 (1934), 1275-1296, 8 figs.] — The author found the amoebae in question to be pathogenic for kittens and albino rats. The dysentery symptom was found in kittens for all three and in albino rats for two. The clinical and pathologico-histological findings on these experimental cases are entirely similar to those of the human form when introduced into kittens and albino rats. N. Ishii.

474. Studies on the Dysentery Amoeba. Experimental Studies on the Dysentery Amoeba of the Albino Rat. I. Especially on Acute Amoebic Dysentery. Eitaro KITABATAKE. [Manshu Ig. Z., **21**, No. 4 (1934), 623-652, 6 figs.] — 64.1% of albino rats were infected with *Entamoeba dysenteriae* in the rectum. The prodromal stage lasts for 2-9 days, and for 1-4 days after infection, vegetative forms occur in the feces; this is the acute stage. The pH of the intestinal contents of the infected rats is lowered, and the discharged stool is soft but retains form, while there is no mucous bloody diarrhoea, but only lymphocytes and a little mucus in the stool. In the tissue of 42.1% of the infected rats were found the amoebae. When the amoebae multiply too much at the surface of the ulcerations, the surrounding mucous tissues are destroyed and the subjacent muscles may also be affected, though rarely. N. Ishii.

475. Studies on the Dysentery Amoeba. II. *Entamoeba dysenteriae* of the Albino Rat, and the Significance of the House Rat as Carrier of Dysentery Amoeba. (Japanese.) Eitaro KITABATAKE. [Manshu Ig. Z., **21**, No. 5 (1934), 827-842, 7 figs.] — Experimentally infected albino rats discharge cysts after 3-6 days, during which only vegetative forms come out. The discharge of the cysts lasts for 13-37 days, the length of the period depending on the extent of the injury suffered by the mucosa during the acute stage. During the discharge of the cysts the intestinal mucosa of the host undergoes no loss. The amoebae were found in the intestinal lumen but not in the tissue. At this stage scars of the mucosa could be seen with the naked eye and the glandular canals were either absent or fewer. The lesion caused by the amoebae cures naturally, and the cysts disappear from the feces. As the carrier of dysentery amoeba the house rat has no great significance. N. Ishii.

476. Parasitism of *Thelazia collipaeda* in Man in Chosen. (Japanese.) Kaoru NAKATA. [Chosen Ig. Kw. Z., **24**, No. 6 (1934), 939-944, 4 figs.] — A case of *Thelazia collipaeda* in the conjunctiva of a Chosen girl. The worm was a female 16.7 mm long and 0.38 mm wide, and the contained larvae 0.22 mm long and 0.02 mm wide. It is the first case of the worm in Japan. N. Ishii.

477. The Influence of Icterus on the Infection and Development of *Schistosomum japonicum*. (Japanese.) Taro SONODA. [Guni Dan Z., No. 250 (1934), 499–530, 20 figs.] — Experimental studies on the influence of icterus upon the icterus and development of *Schistosomum japonicum* in rabbits. That icterus acts unfavorably on the worms, is shown by the longer time required for penetrating the skin, or by obstruction or by the death of the worms and the weak state of the worms, which can infect the healthy rabbits and develop in them but not in icterus rabbits. The worms have to some degree the power of resisting icterus, and may become gradually used to increased icterus and immune to it. In too strong icterus, the worms die during penetration. It appears that in icterus toxic choleric elements accumulate in the blood and tissues and that an unknown toxic by-product acting unfavorably on the worms is produced and brings about changes in the constitution of the host. N. Ishii.

478. Studies on *Paragonimus westermani*. (I. Report.) Esoecially on the Encysted Larvae in *Eriocheir japonicus*. (Japanese.) Masumi WATANABE. [Okayama Ig. Z., **46,** No. 7 (1934), 1514-1532, 24 figs.] — The cysts of *Paragonimus westermani* after being formed in the body of the crab, passively await being taken in by the final host and do not come out of itself, but when during its parasitic life the untoward conditions come on it may leave the cyst or die in it. The cysts are usually attached to the surrounding tissues but may sometimes lie free in the crab body. After the death of the host the cysts may continue to live for 5 or 6 weeks, but only 10–30 days when left free in the water. N. Ishii.

479. Observations on *Cysticercus fasciolaris* Fed to Cats and Dogs. (Japanese with English summary.) Kiojun KAN. [Keio Ig., **14,** No. 6 (1934), 887-899, 12 figs.] — Development is completed in one and a half months after the administration of the onchospheres, and the cysts become infective after about two months. Experimental infection gave positive results in nearly 100% of cases, but successful reinfection gave lower percentage, so that an infected host seems to be more resistant to further infections. The cyst wall and the caudal bladder disappear within 2 hours, and 50–100 posterior segments are lost. The number and shape of the hooks are quite identical in the larva and adult. *Cysticercus* 348 days old did not show any trace of sexual organs. The organs appear 2 days after feeding and reach completion in 2-3 weeks. After 1.5–3 months the onchospheres begin to appear in the feces, and may continue to do so for about 7–8 months. The duration of life seems to be at most one year. *Taenia crassicollis* is found sometimes attached to the inside of the stomach. Development can proceed to the formation of sexual organs also in the dog. N. Ishii.

480. On the Influence of Temperature upon the Development of *Ascaris* Eggs. (Japanese with English summary.) Tadanori AOKI. [Keio Ig., **14,** No. 2 (1934), 293-305.] — *Ascaris* eggs suspended in water die in 50 minutes when heated to 50°C, in 10 hours when heated to 45°C, and in 84 hours when heated to 40°C. N. Ishii.

481. On Microscopic Ingredients of the Coelomic Fluid of *Ascaris*. (Japanese with English summary.) Jirohachi MENJO. [Keio Ig., **14,** No. 1 (1934), 13–20,] — Minute spherical bodies, showing the reactions of fats, were observed in the clear, transparent fluid. They are, however, not an essential component of the fluid but inclosures of the muscle cells of the body wall. Injury to the cells of the body wall is unavoidable in operations for getting the coelomic fluid. In some cases fine granules of various kinds were observed. Even the body wall can not be absolutely removed, and the appearance of such bodies in the fluid is also unavoidable. If the worms are not perfectly healthy, the fluid is naturally not free from various kinds of ingredients having their origin in the body wall and in the contents of the intestine. The author concludes that there are no formed elements in the coelomic fluid of *Ascaris*. N. Ishii.

482. Spiders from Hokkaido. Saburo SAITO. [Jour. Fac. Agr., Hokkaido Imp. Univ., **33** (1934), Pt. 5, 267-362, 24 pls.] — The material consists of spiders collected from all localities in Hokkaido and belongs to fourteen families, forty genera and eighty three species. The following twenty two are new species: *Oecobius sapporense, Oxyptila nigrifrons, Xysticus sapporensis, Philodromus flavidus, Clubiona glatiosa, Castianeira albimaculata, Aelurillus subfestivus,*

Icius daisetsuzanus, Teutana albimaculosa, Argyrodes yesoensis, Argyrodes silvicolum, Oedothorax trilineatus, Nesticus cericeus, Argiope aurea, Araneus tokachionus, Tetragnatha yesoensis, Cicurina maculipes, Cryphoeca angularis, Tarentula ishikariana, Tarentula flavitibia, Lycosa daisetsuzana. The author is of opinion that the araneid fauna of Hokkaido is a mixture of northern and southern elements. Tohru Uchida.

483. Flatfishes Found in Northern Japan. Toyoji HIKITA. [Bull. School Fish., Hokkaido Imp. Univ., **4** (1934), 187-296, 29 pls.] (Japanese, English résumé 10-15.) — Detailed descriptions of the external and internal characters of 30 species belonging to 22 genera, from Hokkaido, Sakhalin and the Kurile Islands, with good photographs of bones. *Pseudoplatichthys oshorensis* n. g. n sp. differs from *Platichthys* in the dextral body, more bony prominences on cranium, vertical fins with comparatively indistinct black bars and fewer stellate tubercles on body surface. Tohru Uchida.

484. Sechs Neue Arten der Chilopoden aus Japan. Yosioki TAKAKUWA. [Trans. Sapporo Nat. Hist Soc., **13**, No. 4 (1934), 398-406.] – Beschreibungen von *Thalthybius tenuicolis, Nesogeophilus tiosianus, N. kozuensis, N. littoralis, Geophilus monoporus* und *Crytops japonicus.* Tohru Uchida.

485. Hydracarina from Saghalien. Tohru UCHIDA. [Trans. Sapporo. Nat. Hist. Soc., **13**, No. 4 (1934), 407-409.] — New records of four known species. Author.

486. Two Species of Whale-lice (Amphipoda, Cyamidae) Parasitic on the Right whale. Masao IWASA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool., **3**. No. 1 (1934), 33-39, 4 pls.] — Description of *Cyamus ovalis* and *C. erraticus* found attached to the skin of a right-whale captured in the North Pacific off Hokkaido. Author-Tohru Uchida.

487. A New Amphipod (*Parhyale kurilensis* n. sp.) from Urup. Masao IWASA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool., **3**, No. 1 (1934), 1-7, 1 text fig., 2 pls.] — This new species of Talitridae was found on the shore of Urup Islands (Middle Kurile Islands), and is the second species of the genus *Parhyale*, differing from the type species, *P. fasciger*, in the form of the first and second antennae, of the mandibles, of the gnathopods, and in its larger size. Author-Tohru Uchida.

488. A Brood-caring Actinian Subject to Wide Range of Colour Variation. Tohru UCHIDA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool., **3**, No. 1 (1934), 17-31, 1 pl.] — Description of external aspect and internal anatomy of the actinian bearing young individuals on the column, giving variations of the sphincter and descriptions on the mesenteries at different stages. The colorations and color patterns which are very different according to individuals, seem to be of génic origin, because (1) several individuals of different colorations occur together in a limited locality exposed to almost identical photic and tidal influences; (2) young individuals attached to a mother have always a nuance similar to the latter, though the patterns may be indistinct; (3) individuals fall into two groups, plain-colored and radially streaked, in the latter the patterns coinciding broadly with one another; (4) the colorations and color patterns seem to be constant, though seemingly subject to random variations. The species seems to be identical with *Epiactis ritteri* Torrey or *Bunodes japonica* Verill. Author.

489. Some Rheiphilous Water-mites from Japan. Tohru UCHIDA. [Jour. Fac. Sci., Hokkaido Imp. Univ., Ser. VI, Zool., **3**, No. 2 (1934), 67-116.] — Descriptions of 15 species of torrenticolous water-mites from Honshu and Hokkaido. All but one are newly recorded from Japan. The following new subgenus and new species are described: *Protzia japonica, Sperchon fluviatilis, Pseudosperchon nipponicus, Rivobates ezoensis, Aturus ovalis, A. miyashitai, Feltria* (*Mesofeltria* n. subgen.) *torrenticola, F.* (*Mesofeltria*) *rotunda.* Author.

490. Notes on the Ipidae (Coleoptera) from Kiushu. Jozo MURAYAMA. [Ann. Zool. Jap., **14**, No. 3 (1934), 287-300.] — Descriptions of 7 new species and 3 new forms of the genus *Xyleborus* and a list of the hitherto described species. *Stephanoderes amakusanus* resembles

Hypothenemus peritus, but the body is smaller, more slender, tubercles of prothorax weaker, posterior surface of prothorax rugose, without median elevated line, elytra longer, hairs of punctures almost invisible. *X. kumamotoensis*, allied to *X. submarginatus*, with posterior half of prothorax dull, bared interstices of elytra, characteristic arrangement of tubercles on elytral declivity. *X. kadoyamaensis*, allied to *X. minutus* but differing in the longer body, stronger tuberculation and squamous setae in declivity which is not impressed. *X. calamoides*, allied to *X. amputatus* but smaller. *X. osumiensis* resembles *X. sexspinosus* in the construction of prothorax, but the elytral declivity is not excavated and the spines are very small and obtuse; elytral surface nearly same as in *X. apicalis*, but in the new species the rugose punctures are slightly exasperate in the posterior part of prothorax, the elytral declivity is carinate below and the second interstice elevated with series of larger spines. *X. onoharaensis*, characterized by the incision of the anterior border of prothorax found in none of the allied Japanese species. And the vast impression of the elytral declivity. *X. naganoensis*, differing from *X. kumamotoensis* by the possession of small unicornuate prothoracic prolongation and in having the elevated interstices with narrow and punctured lines almost straight; it is probably the male of *X. badus* or *X. attenuatus*. Males of the *X. bicolor*, *X. adumbratus*, and *X. pelliculosus* have been found. Z. Kuwana.

491. Sur quelques syllidiens du Japon. Pierre FAUVEL. [Ann. Zool. Jap., **14**, No. 3 (1934), 301–315, 2 figs.] — Description of 12 syllids from Seto and Misaki, 8 species of *Syllis* and one each of *Trypanosyllis*, *Odontosyllis*, *Exogone* and *Autosyllis*. *Syllis okadai* n. sp., resembling *S. torquata* but characterized by the 'palpes et prostomium enfumés; 1er et 2e segments sétigères violet foncé, presque noir; ensuite 4 segments blancs, puis 3 segments violet foncé et 2 segments légèrement brunâtres. Le reste du corps est brun violacé, ou gris-brun, avec deux rangées longitudinales de taches claires, ocellées, alternantes et, à la base de chaque parapode, une tache claire, devenant allongée dans la region postérieure ou le pigment se réduit a un simple pointillé. Face ventrale incloré'. The author is of opinion that *S. torquata* of Misaki is only a colour variation of *S. Okadai* and not the same as the Mediterranean species. Z. Kuwana.

492. *Amblyosyllis nigrolineata*, une nouvelle Variété de l'*A. speciosa* Izuka. Yo K. OKADA. [Ann. Zool. Jap., **14**, No. 3 (1934), 317–320, 2 figs.] — This new type is found abundantly at Misaki, always in association with a certain sponge. It is characterized by the possession of three dorsal bands, a dark brown one near the posterior end of a segment, a large one of lighter colour at the anterior part, and a non-pigmented one between the two. Z. Kuwana.

493. Two Species of the Sedentary Polychaete *Pectinaria*. Shiro OKUDA. [Ann. Zool, Jap., **14**, No. 3 (1934), 321–326, 6 figs.] — Revised descriptions of *Pectinaria bocki* and *P. japonica*. Z. Kuwana.

494. Eine Holothurie mit zwei Afteröffnungen. Hiroshi OHSHIMA. [Ann. Zool. Jap., **14**, No. 3 (1934), 327–330, 2 figs.] — A dried *Holothuria argus*, 45 mm. long, properly prepared for sale as 'Bicho-do-mar' at Bougainville Territory of British New Guinea. After 2 days' maceration, it attained the length of 80 mm. The posterior end is bifurcate, the right furca being longer. The internal organs are almost completely absent. Attached to the body wall, are the five conspicuous longitudinal muscle bands, of which three run into the right furca and 2 into the other. The circular muscles form an independent tube for each furca. The author concludes that this example has 2 ani. Z. Kuwana.

495. A Gourd-shaped Sea-urchin. Hiroshi OHSHIMA. [Ann. Zool. Jap., **14**, No. 3 (1934), 331–337, 1 pl.] — The specimen, referred with some doubt to *Strongylocentrotus intermedium*, has an elongated body axis, and the ambulacral and interambulacral plates are arranged obliquely or bent here and there. The actinostome is small. Z. Kuwana.

496. Two New Forms of the Pauropoda from Japan. Teiso ESAKI. [Ann. Zool. Jap., **14**, No. 3 (1934), 339–345, 1 pl.] — Descriptions of specimens from the Island of Okinoshima. *Eurypauropus okinoshimaensis*, allied to *E. hastatus*, but different in the relative size of the parts of antenna and of the tergites, as well as in the structure of the tactile hairs. *Thaumatopauropus*

gen. nov., distinct from *Eurypauropus* in the structure of the tergites, antenna and legs; the tergites are extraordinarily well developed and strongly convex; the antennae are stout, with 4-segmented scape; stylus angustior long and slendor, stylus latior thicker and shorter, inner flagellum and globulus at the tip, stalk of globulus very short; legs 5-segmented, tarsi slender, claws long with a smaller one under it, coxae with a stout seta. *T. glomerans* sp. nov., body bright chestnut-brown 1.33 mm. long. Z. Kuwana.

497. Sur *Lophopodella cartesi* (Hyatt), Bryozoaire d'eau douce, originaire de Formose. Sadaé TAKAHASI. [Ann. Zool. Jap., 14, No. 3 (1934), 347-353. 1 pl.] — Ecological notes. Z. Kuwana.

498. Neue Japanische Mecistocephalidae. Yoshioki TAKAKUWA. [Ann. Zool. Jap., 14, No. 3 (1934), 355-363, 11 figs.] — Descriptions of *Dicellophilus latifrons*, *Tygarrup moiwaensis*, *Prolamnonyx obtusus*, *P. dentatus*, *Mecistocephalus ongi* and *M. brevisternalis*. Z. Kuwana.

499. Notes on *Diaptomus okadai* sp. nov. Isamu HORASAWA. [Ann. Zool. Jap., 14, No. 4 (1934), 369-371, 1 fig.] — Allied to *D. lobatus* and characterized as follows: anterior part of the female genital segment with greater lateral expansion, the hyaline lamella of the antepenultimate segment of the anterior antenna of the male armed with a tooth, inner ramus of the fifth leg of the female about half as long as the first segment of the exopodite, a semicircular process situated on the inner margin of the first segment of exopodite of the right fifth leg of the male. Z. Kuwana.

500. Experimental Studies on the Embryonic Development of Cricket. Hidemiti OKA. [Ann. Zool. Jap., 14, No. 4 (1934), 373-376, 4 figs.] — A definite portion of a freshly laid egg of *Gryllus miratus* was thermocauterized. 8 out of the 100 thus treated developed into complete embryos, though much smaller in size. This shows that the eggs of this group of insect belong to the regulative type, instead of the mosaic one. Z. Kuwana.

501. Notes on the Osteology of a Three-legged Duckling. Tsen Hwang SHAW. [Ann. Zool. Jap., 14, No. 4 (1934), 377-380, 2 figs.] — Observation on the newly hatched duck, preserved in alcohol. An extra leg projects from the posterior part of the body. The last few sacral vertebrae and the caudal region are twisted toward the right side. The right half of the pelvic girdle is normal, but the left one is much larger and deformed. There are 3 acetabulae on the pelvis, the anterior two opposite each other but the posterior one a little further behind and articulated with the extra leg. The left ilium is V-shaped. The extra leg is shorter and possesses 5 digits, the middle digit being unconnected with the others at the basal part. Z. Kuwana.

502. Mayflies from Japanese Torrents. IV. Notes on the Genus *Epeorus*. Kinji IMANISHI. [Ann. Zool. Jap., 14, No. 4 (1934), 381-395, 1 fig., 1 pl.] — Descriptions of 9 species, of which 3 are new. *E. uenoi; E. aesculus* n. sp., allied to *E. uenoi* but distinguished by the fuscous spot on the propleuron and the peculiar shape of the penis-lobe; *E. nipponicus; E. hiemalis* n. sp.; *E. ikanonis; E. psi; E latifolium; E. napaeus* n. sp., the largest mayfly of the genus, 14-16 mm. long, closely resembles *E. latifolium; E. curvatulus.* Z. Kuwana.

503. The Disposal of Worn-out Erythrocytes by Intestinal and Branchial Epithelia in Lamprey. Syunzo TAKAGI. [Ann. Zool. Jap., 14, No. 4 (1934), 397.] The intestinal and branchial epithelial cells of *Entosphenus japonicus* are very often found to contain erythrocytes and their debris, and their nuclei can be seen occasionally, while the hemoglobin reaction is positive. How they come to lie in the cells remains unknown. Z. Kuwana.

504. Eine neue *Bombus ignitus* Smith ähnliche Schmarotzerhummer aus Korea (Hymenoptera, Bombidae.). Keizo YASUMATSU. [Ann. Zool. Jap., 14, No. 4 (1934), 399-403, 1 fig.] — Description of *Psithyrus* (*Ashtonipsithyrus*) *coreanus* sp. nov., a key to palearctic species of the subgenus *Ashtonipsithyrus*, and a list of the species of the genus *Psithyrus* from southern Sakhalin, Korea and Formosa. The new species differs from the allied species in the structure of the genitalia. Z. Kuwana.

505. A New Species of *Eulecanium* (Coccidae). Sigeo KANDA. [Ann. Zool. Jap., **14**, No. 4 (1934), 405–411, 1 fig., 1 pl.] — Description of *Eulecanium kuwanai*. Z. Kuwana.

506. On *Pseudobonellia*, a New Genus of the Bonellian Echiuroids. Katsuzo ONODA. [Ann. Zool. Jap., **14**, No. 4 (1934), 405–411, 1 fig., 1 pl.] — The new generic name, *Pseudobonellia*, is proposed for *Bonellia misakiensis* Ikeda, on the ground of the absence of ventral hooks. The generic diagnosis is as follows: body swollen, proboscis long, bifurcates at the apex; a single anterior nephridium (oviduct) and 2 posterior nephridia (anal glands), with ciliated funnels; ventral hooks entirely absent; male nematode-like, without mouth or anus. Type species: *P. misakiensis* (Ikeda). Z. Kuwana.

507. On *Clemmys mutica* (Cantor) with Special Reference to its Variation and Distribution. Kenji NAKAMURA. [Ann. Zool. Jap., **14**, No. 4 (1934), 425–435, 5 figs., 1 pl.] — In *Clemmys mutica*, the relative position of the entoplastron and the humero-pectoral seam is not constant. One of the generic characters of *Cathaiemys*, that the entoplastron lies in front of the humero-pectoral seam, is of itself not enough to justify the erection of a separate genus from *Clemmys*. Z. Kuwana.

508. On a Tubicolous Polychaete living in Commensal with a Pycnogonid. Shiro OKUDA. (Ann. Zool. Jap., **14**, No. 4 (1934), 437–439, 3 figs.] — A pycnogonid, *Lecythorhynchus hilgendorfi* was found carrying upon the body several tubes of *Spirorbis spirillum*. Z. Kuwana.

509. Subterranean Crustacea from Kwantung. Masuzo UENO. [Ann. Zool. Jap., **14**, No. 4 (1934), 445–450, 3 figs.] — *Pseudocrangonyx asiaticus* sp. nov. (Gammaridae), with a distinct second joint in the third uropod and differing from other species of the genus by the large terminal joint of the third uropod, the deeply emarginate telson, and by the first and second uropods extending much beyond the telson: *Asellus aquaticus* (Asellidae); *Eucyclops nagasakai* (Cyclopidae). Z. Kuwana.

510. On the Nymph of a Dragonfly, *Epiophlebia superstes* Selys. Haruo FURUKAWA. [Ann. Zool, Jap., **14**, No. 4 (1934), 451–456, 9 figs.] — Morphological notes. Z. Kuwana.

511. Studies on the Mermithid-worm Parasitic in *Margaronia pyloalis* Walker. (Japanese with English résumé.) Tametoshi YAMAUCHI. [Bull. Imp. Sericul. Exp. Sta., **8**, No. 8 (1934), 383–424, 1 pl.] Z. Kuwana.

512. Tetranychid Mites Attacking the Mulberry Leaf. II. External Structure and Bionomics of *Panonychus mori* Kishida. (Japanese with English résumé.) Kirio YOKOYAMA and Goro ISHII. [Bull. Imp. Sericul. Exp. Sta., **8**, No. 9 (1934), 425–454, 1 pl.] Z. Kuwana.

513. Formation of an Individual by the Union of Two Sperm Nuclei in the Silkworm. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul. Exp. Sta., **8**, No. 10 (1934), 455–464.] — 1) "When a male d-oily (od) was crossed with a normal female, and the eggs obtained therefrom were exposed, immediately after the oviposition, to a higher temperature (about 40°C.) for 1 hour, a few of them developed to exceptional worms, od males, where od females and normal males were expected. Further study showed that this male was not only exceptional as regards sex-linked inheritance, but also in regard to an autosomal character; when the male parent carried an autosomal recessive, the exceptional male showed always the recessive character, even if the female parent carried the dominant allelomorph. This peculiar phenomenon was considered attributed to merogony. (Hashimoto, 1929, Jap. Journ. Genetics, vol. 4.)" Further observations brought to light several facts indicating the diploidy of the exceptional male, such as the occurrence of maturation division and the normal faculty of fertilization. If the sperm-development actually takes place, then a problem arises regarding the diploidy: whether

the diploidy is due to the duplication of chromosomes in a later stage or to the union of two sperms at the beginning. The object of the present study was to decide between these two alternatives. 2) As a material, a male, d-oily and heterozygous for supernumerary (Kp), was prepared. (The homozygous Kp has a pair of supernumerary abdominal legs and an extra pair of lunar color patterns, while the heterozygous one possesses only the supernumerary legs, so that the homo- and heterozygote can be easily detected.) This male was mated with a normal female and the eggs, when treated as above stated, gave rise to three exceptional kinds: d-oily males, normal females and male mosaics (od and normal) and gynanders (od). (The normal females are not dealt with in this paper.) As regards Kp, the od males consisted of three kinds of individuals: homozygous Kp, heterozygous Kp and normal, in the ratio of 1:2:1. This result shows clearly that the exceptional male develops from the union of two sperm nuclei. The mosaics and the gynanders may be explained by the assumption that the union of sperm nuclei occurs parallel with the normal fertilization within the same egg. If the union takes place in the Z egg, the result is a mosaic of od and normal; if it takes place in the W egg, the result is an od gynander.

Z. Kuwana.

514. Studies on the Linkage in the Silkworm. I. Quail and B 8 Mottled. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul. Exp. Sta., 8, No. 10 (1934), 467–472, 1 fig.] — A linkage was found between the quail (q) (with a color pattern like that of a quail along the subdorsal lines) and the B 8 mottled-oily (bt) (a mosaicism of oily and normal), both being simple autosomal recessives. F_1 of the cross between them is normal in phenotype. In F_2, appear normals, quails and mottleds in the ratio of 2:1:1, double recessives and quail mottled not occurring. If the F_1 female is backcrossed with the double recessive male, quails and mottleds appear in equal numbers. The reciprocal backcross produces quails and mottleds in large numbers and quail mottleds and normals in small numbers. These results show the existence of linkage between these two characters, complete in the female but crossing-over in the male. The linkage value is 11.6% on an average. There is an independent assortment between the mottled and the second chromosome gene Yellow, the third one Zebra, and the fourth one Multilunar. Mottled and quail therefore form a new linkage group. Z. Kuwana.

515. Studies on the Linkage in the Silkworm. II. A Linkage between the Supernumerary and the lk Lethal. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul. Exp. Sta., 8, No. 10 (1934), 473–479.] — The lk lethal is a non-sex-linked character which shows during the embryonal stage. There is a linkage relationship between lk and Kp and the cross-over value is 17.7%. Kp shows an independent assortment with Yellow, Zebra, Multilunar and B 8 Mottled-translucent respectively. Therefore, the supernumerary forms a new linkage group with the lk lethal. Z. Kuwana.

516. Unstable Translocation of the Z Chromosome to an Autosome in the Silkworm. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul. Exp. Sta., 8, No. 10 (1934), 481–503, 2 pls.] — A female pupa heterozygous to Y and Kp was X-rayed 1 or 2 days before the emergence. The moth was mated with a male heterozygous to od. In F_1, a mosaic mutant appeared, with mottled d-oily and normal parts (p-mottled oily or pt). 1) Besides the visible character, the pt carried a lethal sex-linked gene. The lethal was studied separately from the mottled. When the male of the lethal line which is normal in phenotype is crossed with the od female, half the number of males in F_1 are d-oily, a result entirely unexpected from ordinary sex-linked inheritance. On the other hand, when the male of the same line is mated with the s-oily (os situated on the left end of the Z chromosome, while od on the right end), all the progeny are normal. Further breedings show that 50.0% crossing-over occurs between os and the lethal but none between od and the lethal. As the crossing-over value between os and od is 46.2%, the lethal should be on the same locus as od. Therefore, it is concluded that the lethal action is caused by the deficiency of od locus on the Z chromosome. 2) The behavior of p-mottled in heredity is peculiar; it is recessive to normal and dominant to d-oily, a sex-linked gene, but behaves as an autosomal instead of a sex-linked character. Therefore, the dominant allelomorph of p-mottled to d-oily must be on an autosomal chromosome. This shows that the locus of d-oily of the Z chromosome was translocated to an autosomal chromosome by irradiation. Further experiments show that the Z chromosome of p-mottled carries d-oily, so that p-mottled

is heterozygous with respect to d-oily. Thus, heterozygous individuals should be normal in phenotype, if not interfered with. But as a matter of fact, there occurs the mosaic, p-mottled. This is explained by the following assumption: the attachment of the translocated fragment of the Z chromosome to the autosome is not firm, and the fragment is easily eliminated during the development; some of the somatic cells are deprived of the dominant allelomorph of od by the elimination, and consequently the od, which has lain dormant, becomes active, while others retain the fragment and maintain the normal character, the result being mosaics. 3) The p-mottled being dominant, in F_1 of the backcross between pt and od, they should come out in equal numbers. But actual breeding shows that pt is much less in number than od; the explanation lies in the elimination of the translocated fragment during gametogenesis. Z. Kuwana.

517. Genetical Studies on the Tetraploid Female in the Silkworm. II. Occurrence of Tetraploid Female in a Gynandromorphous Strain. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul Exp. Sta., 8, No. 10 (1934), 505–514.] - A few females exceptional with regard to sex-linked inheritance appeared in F_1 of the cross between a female of a certain gynandromorphous strain and a normal male. Some of them are regarded as tetraploid, because they have many similarities to the tetraploid females reported in the previous paper. The nature of these tetraploid females is clarified by the behavior of the autosomal genes. If a dominant gene enters into the exceptional female from the male parent, the F_1 of her backcross gives the ordinary segregation ratio, 1:1. But, if it comes from the female parent, all the F_1 of the backcross is of the dominant type. This apparent anomaly can be explained by the assumption that the exceptional females are tetraploid and that the tetraploidy is due to the fertilization of a triploid " Richtungskopulationskern " with a normal sperm nucleus. If a triploid female nucleus aaa is fertilized by a male A, the F_1 will be Aaaa, and if AAA is fertilized by a, AAAa will result. It is assumed without further study that the formation of tetraploids in the gynandromorphous strain is a character due to maternal inheritance.

Z. Kuwana.

518. Genetical Studies on the Tetraploid Female in the Silkworm. III. Behaviour of the Z Chromosome. (Japanese with English résumé.) Haruo HASHIMOTO. [Bull. Imp. Sericul. Exp. Sta., 8, No. 10 (1934), 515–523.] — It was reported in a previous paper that the tetraploid contains two Z chromosomes and these chromozomes should always go into the two daughter cells during maturation division (see abstract 290 of this Journal, Vol. vi, No. 1), but it could not then be shown that in some cases both the Z chromosomes may not go to one pole. Recently tetraploid females with two Z chromosomes were obtained from a certain gynandromorphous stock. Crossing the tetraploid female homozygous to the dominant gene with the d-oily male, gave only normal F_1. As a result it is safely concluded that the F_1 carries two Z chromosomes irrespective of sex, one from the mother and the other from the father, so that the two Z chromosomes never go to the same pole. Z. Kuwana.

519. Catalogue of the Shell-bearing Mollusca Collected from the Kesen and Motoyoshi Districts, Northeast Honsyû, Japan, Immediately after the Sanriku Tunami, March 3, 1933, with Descriptions of Five New Species. Sitihei NOMURA and Kotora HATAI. [Saitô Hô-on Kw. Mus. Res. Bull., 5, 1–47, 2 pls. (1935).] — 94 species of Pelecypoda, 3 of Scaphopoda, 138 of Gastropoda and 5 of Amphineura, beached by the seismic ocean waves. The more notable features were that, (1) large numbers still contained the soft parts, (2) some were still alive for about a week after, (3) water worn shells were rare, broken ones were common, (4) only the littoral forms were represented, (5) land and marine shells were intermingled, the former first brought down by the waves, on their retreat from the hill side and thrown up again. From these data it is concluded that in spite of the great magnitude of the waves, their digging and shearing activities are restricted to the littoral zone roughly within the depth of 10 meters. S. Ohfuchi.

520. On the Fathomic Records of Some Species of Mollusca from the Continental Shelf Bordering Mostly Northeast Japan. Sitihei NOMURA and Kotora HATAI. [Saitô Hô-on Kw. Mus. Res. Bull. 5, 49–53 (1935).] — The depths at which several common marine mollusca have been found, are listed. S. Ohfuchi.

521. A Note on a Recent Cirriped. Kotora HATAI. [Saitô Hô-on Kw. Hak. Zihô, 27., 2 pp. 3 figs. (1935)] — The widely distributed *Coronula diadema* (Linné). S. Ohfuchi.

522. A List of the Birds Collected from North Eastern Hondo, Japan. The First Report; Passeres, Cypseli, Caprimulgi, Halcyones, Pici and Cuculi. Shinryo OHFUCHI. [Saitô Hô-on Kw. Mus. Res. Bull., 3, 13 pls. (1934).] — 112 species and subspecies belonging to 67 genera, 23 families and 6 orders are listed. The plates are remarkable. Author.

523. On Some Recent Brachiopoda from Northeast Japan. Sitihei NOMURA and Kotora HATAI. [Saitô Hô-on Kw. Mus. Res. Bull., No. 2, 20 pp., 2 pls. (1934).] – The recent Brachiopoda in the collection of the Saitô Hô-on Kw. Museum are dealt with. The other forms from the waters bordering the six prefectures of Northeast Japan, though not represented in the collection, are enumerated for comparison. The forms dealt with are *Hemithyris psittacea* (Gmelin), *Terebratulina crossei* Davidson, *T. japonica* (Sowerby), *Terebratalia coreanica* (Adams et Reeve), *Coptothyris grayi* (Davidson), and *Laqueus rubellus* (Sowerby). S. Ohfuchi.

524. Studies in the Biochemistry of Copper. III. Distribution of Copper between the Corpuscles and Plasma. Uichiro SAKATA. [Jap. Jour. Med. Sci., II. Biochem., 2, No. 3 (1934), 305-308.] — The inconstancy in previous findings is presumably due to inadequacy of methods. Careful reinvestigation by improved method showed that the copper content is far higher in the corpuscles (about 4/5 of the total) than in the plasma and serum. The materials used were those of man, ox, horse and rabbit. Y. Kimura.

525. Studies in the Biochemistry of Copper. IV. The Copper Content of Red and White Blood Cells. Akio SUZUKI and Uichiro SAKATA. [Jap. Jour. Med. Sci., II. Biochem., 2, No. 3 (1934), 309-312.] - The copper content is nearly 3 times as great in the red cells as in the white ones, but the distribution of the metal is practically equal for the contents and stromata of the cells. The material was horse blood. Y. Kimura.

526. Zur Frage des Vorkommens anderer Zuckerarten als Glukose im Blut. Hiro'o OKAMURA. [Jap. Jour. Med. Sci., 2, No. 3 (1934), 313-321.] — Aus dem Blut des Fleisch- (Hund) und Pflanzenfressers (Rind) wurde eine Lävulosefraktion unter möglichst einwandfreien Bedingungen dargestellt. In dieser Fraktion traten die Reaktionen von Selwanoff, Tashiro und Tietz, mit glykocholsaurem Natrium, von Creveld und Yamada deutlich positiv auf. Polarimetrische Untersuchung und Versuche an Phenylmethylosazon zeigten auch die Anwesenheit von Lävulose deutlich. Aus diesen Befunden schliesst der Verf., dass Lävulose sich im normalen Blut findet. Y. Kimura.

527. Über das Blut der Wild- und Hausente, mit besonderer Rücksicht auf seinen Chlor- und Lävulosegehalt. Ein Vergleich der Stamm- und Haustiere. Hiro'o OKAMURA. [Jap. Jour. Med. Sci., II. Biochem., 2, No. 3 (1934), 323-339.] — Das Blut der Wild- und Hausenten zeigt, soweit in dieser Arbeit behandelt wird, keinen wesentlichen Unterschied. Alle Versuche wurden im Winter durchgeführt, und bei Blutentnahme wurde Sorge dafür getragen, den Vogel möglichst ruhig zu halten, um zeitweilige Hyperglykämie und andere labile Erscheinungen auszuschliessen. Das Blut für die Chlor- und Zuckerbestimmungen wurde aus der Schwimmhautvene entnommen, eine zuerst vom Verf. anerkannte vorzügliche Quelle für Blutprobe, während für andere Untersuchungen das Blut wie üblich auch aus der Flügelarterie genommen. Die durchschnittliche Werte jedes untersuchten Bestandteils pro 100 ccm Blut ergaben sich wie folgt. Der Chlorgehalt (als NaCl) beträgt 465 ± 13.9 mg bei der Stockente und 452 ± 9.6 mg bei der Hausente. Der Zuckergehalt (als Glukose) beträgt 116 ± 0.8 mg bei der Stockente und 114 ± 0.7 mg bei der Hausente. (Der bisher für Vögel angegebene Blutzuckergehalt scheint allzu hoch zu sein.) Der Lävulosegehalt beträgt bei beiden Arten um 5 bis 7 mg. Die Gesamt- und Harnstoffstickstoffe beträgen 32.9 ± 0.94 mg bzw. 7.6 ± 0.32 mg bei der Stockente und 35.6 ± 0.81 mg bzw. 5.3 ± 0.10 mg bei der Hausente. Der Harnsäuregehalt beträgt 6.7 ± 0.44 mg bei der Stockente und 5.6 ± 0.13 mg bei der Hausente. Y. Kimura.

528. Kurze Mitteilung betreffend organische Phosphorverbindungen des Acht-

füssers. Saburo SUZUKI. [Jap. Jour. Med. Sci., II. Biochem., 2, No. 3 (1934), 355-357.] -- Das im Cephalopodenmuskel befindliche Phosphagen ist nicht Kreatinphosphorsäure, sondern scheint eine unreine Argininphosphorsäure oder ein neues Phosphagen zu sein. Als Versuchstier diente *Octopus octopodia.* Y. Kimura.

529. Cystine and Cysteine in Relation to Overstrain of the Muscle. M. ITAGAKI, M. ODAGIRI and Z. KABUKI. [Jap. Jour. Med. Sci., II, Biochem., 2, No. 3 (1934), 381-399.] --- That the remarkable increase in the amount of cysteine and cystine after severe muscular exercise both in the blood and urine, is caused by the exercise, may be seen from the following experimental results. The muscle overstrained by the injection of strychnine shows a very high cysteine-cystine content. The cysteine-cystine content is found to increase distinctly in the blood from tetanized muscle. After due operation, a cannula was inserted into the v. saphena for obtaining the blood sample for the control, and then the sciatic nerve was stimulated with an induction current and the test sample was drawn immediately. Rabbits and dogs served as materials. Y. Kimura.

530. The Effect of Changes in the Blood Sugar Concentration on the Level o Oxalic Acid in the Blood. Glucose as a Source of Oxalic Acid. Saburo SUZUKI. [Jap. Jour. Med. Sci., II. Biochem., 2, No. 3 (1934), 401-411.] --- An apparent parallelism is found between the levels of oxalic acid and blood sugar, the injection of glucose causing a rapid increase of oxalic acid. But no significant charge is caused by hexosemonophosphoric acid and a remarkable decrease is brought about by pyruvic acid. Thus, the oxalic acid formation may presumably be associated with the carbohydrate metabolism, but the process may go on in an other way, in which hexosephosphate and pyruvic acid occur as intermediate products. The animals used were rabbits. Y. Kimura.

531. The Influence of Some Amino Acids on the Production of Oxalic Acid in the Animal Organism. Saburo SUZUKI [Jap Jour. Med. Sci., II. Biochem., 2, No 3 (1934), 413-425.] -- The oxalic acid content in the blood is increased by the intravenous injection of aspertic acid and asparagine. 1(+)-α aminobutyric acid seems to act in the same way, laevorotatory antipode being inefficient. No demonstrable effects are caused by glycine, alanine, glutamic acid, and butyric and succinic acid. The experimental animals were rabbits. Y. Kimura.

532. Oxalic Acid in the Blood of Different Kinds of Animals. Saburo SUZUKI. [Jap. Jour. Med. Sci., II. Biochem, 2, No. 3 (1934), 427.] -- Under normal conditions no difinite differences are found between mammals and fishes. The contents lie between 2.8 and 3.9 mg per 100 cc blood or thereabout. Prolonged fasting causes in all cases a fall in the content. Rabbit, ox, swine, dog, carp, sea-bass and salmon were examined. Y. Kimura.

533. Experiments on the Gill Formation in the Urodelan *Triturus*. M. ICHIKAWA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 9, No. 1 (1933), 47-69, 2 pls.] — The faculty of gill formation is possessed in the early neurula stage by the entire body surface except the medullary plate, but as development proceeds gradually becomes localized from behind forwards to the branchial ectoderm at the tail-bud stage, and the polarity of the branchial ectoderm, especially the dv axis, becomes definite by this time. Heterotopic transplantation combined with removal of underlying layers, shows that the branchial ectoderm has no power of self-differentiation, but that the mesoderm is important for gill formation. The endoderm seems to play some part too, since the most typical gills arise from transplantations with all 3 layers. Author - Komai.

534. On the Structure of *Ctenoplana*. T. KOMAI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 9, No. 4 (1934), 245-256.] -- The internal structure of a specimen from Misaki. The general plan is essentially that of a ctenophore, but the body is flattened and shows a distinct dorsiventrality, which is mainly due to the extension of the outer half of the pharynx, besides the reduction of the main axis, much as in *Coeloplana.* Taxonomically, *Ctenoplana* stands between *Coeloplana* and the cydippid, especially like *Lampetia.* Author.

535. Bopyrids from Tanabe Bay. II. S. M. SHIINO. [Mem Coll. Sci., Kyoto Imp.

Univ., Ser. B, 9, No. 4 (1934), 257–287.] — Additions to the previous report. New forms: *Aporobopyrina lamellata* n. gen. & n. sp., *Aporobopyrus oviformis* n. sp., *Parabopyrus kiiensis* n. gen. & n. sp., *Portunicepon goeticii* n. sp., *Diplophryxus alphei* n. sp., *Epiphryxus primus* n. gen. & n. sp., *Hypophryxus yusakiensis* n. gen. & n. sp.. T. Komai.

536. The Freshwater Branchiopoda of Japan. III. Genus *Daphnia* of Japan. 1. Seasonal Succession, Cyclomorphosis and Reproduction. M. UÉNO. Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 9, No. 4 (1934), 289–320.] — *D. pulex* and *D. longispina* occurring in certain ponds in Kyoto were continuously observed for two years. *D. pulex* is either mono- or dicyclic, and in the former case, gamogenesis takes place only in spring; cyclomorphosis is very slight. In *D longispina* two maxima were found in each year; gamogenesis is rare; males appear shortly after the maximum population. T. Komai.

537. The Freshwater Branchiopoda of Japan. IV. Genus *Daphnia* of Japan. 2. Local Races of Japanese *Daphnia*. M. UÉNO. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 9, No. 4 (1934), 321–342 4 pls.] - All the local races of *Daphnia* found in Japan can be referred to *D. pulex* or *D. longispina*. The local variation of *D. pulex* is slight, while that of *D. longispina* is rather great. All the races, except the one occurring in a lake of Hokkaidô, of *D longispina* are brachycephalic, and have concave head profiles. An association of different races of pelagic *Daphnia* is found in none of the Japanese lakes. The difference in pH value alone seems to be responsible for the distribution of various local races. The races living in oligotrophic waters have the upturned spine. T. Komai.

538. Studies on a Peculiar Oscillatory Movement of the Larva of the Ramie Moth, *Arcte coerulea* Guenée. T. YAMADA. [Mem Coll. Sci., Kyoto Imp. Univ., Ser. B, 9, No. 1 (1933), 1–45, 5 pls.] - The caterpillar when stimulated mechanically performs a peculiar swinging movement with the anterior 1/3 of the body. The frequency of the oscillations is ca. 7 per second and this is kept up to the end. The amplitude is up to 24.2 mm. and gradually diminishes. The movement consists of two types, a single preliminary aperiodic 'Abwischreflex' and the remaining periodic oscillatory reflex s. str. The response to stimuli decreases in strength with repetition and finally reaches a state of sensory adaptation. The nervous center of the reflex is probably located in one of the ganglia anterior to the 3rd abdominal ganglion, the most efficient ones lying probably in the 1st to 3rd abdominal ganglia. T. Komai.

539. Sacculinization in *Eriocheir japonicus* de Haan, with Remarks on the Occurrence of Complete Sex-reversal in Parasitized Male Crabs. Y. K. OKADA and Y. MIYASHITA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 10, No. 3 (1935), 169–208. 2 pls.] — When the grapsoid crab *Eriocheir japonicus* is parasitized by a *Sacculina*, (*S. gregarina* n. sp.), the males become intersexual in varying degrees. The changes which occur invariably are the broadening of the abdomen and the loss of the basal bridge of the abdomen; the production of female biramous appendages is also quite frequent. In the extreme case of the male intersex the copulatory styles degenerate completely, 4 pairs of ovigerous appendages are well developed, and male gonopores obliterated. The female secondary sexual characters are little affected by the infection. The gonad of both sexes of parasitized individuals are atrophied and some unquestionable cases of complete change from testis to ovary are met with. T. Komai.

540. Origin and Development of the Photogenic Organ of Lampyrids, with Special Reference to those of *Luciola cruciata* Motschulsky and *Pyrocoelia rufa* Olivier. Y. K. OKADA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, 10, No. 3 (1935), 209–228, 2 pls.] — In the larva of *Pyrocoelia rufa* the photogenic organ is derived from the fat-bodies by the migration of their cells to the ventral hypodermis. There is hardly any difference in shape and size between the photogenic cells and the ordinary fat-bodies. In *Luciola cruciata* however, photogenic cells are 1/10 the size of the fat-bodies. In both species the further development of the organ proceeds in the same way. Except for the ectodermal tracheal elements, the whole organ is of mesodermal origin. The adult photogenic organs develop de novo, without any relation to the larval organs. The process of disintegration of the latter is described. T. Komai.

541. On a New Integumental Poison Gland Found in the Nuchal Region of a Snake, *Natrix tigrina*. K. NAKAMURA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 3 (1935), 229–240, 1 pl.] — Up to 15 pairs of integumental glands occur in the nuchal region of this snake, and they have no lumen or duct and resemble the poison glands of some fishes. The secretion stored in the cells are extruded through breaches in the skin by mechanical pressure. The fluid is neutral in reaction, contains crystals and granules, and causes rather severe irritation of the mucous membrane. T. Komai.

542. *Neoaschizomys*, a New Genus of Microtinae from Sikotan, a South Kurile Island. M. TOKUDA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 3 (1935), 241–250, 1 pl.] — Description of a new representative of the primitive vole, *N. sikotanensis*, n. g. et sp., allied to *Aschizomys*, *Alticola* and *Clethrionomys* but differing in several respects. The occurrence of such a vole in one of the Kurile Islands seems to indicate an ancient land connection between the Japanese Islands and the Maritime Provinces. T. Komai.

543. On *Stephanoscyphus* and *Nausithoë*. T. KOMAI. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 5 (1935), 289–339, 2 pls.] — Detailed accounts of the structure and strobilation of the peculiar colony forming scyphopolyp, *Stephanoscyphus mirabilis* Allman (=*Spongicola fistularis* F. E. Schulze) and also on the development of its medusoid stage *Nausthoë punctata* Kölliker. The colony has a chitinous periderm which undergoes triple or quadruple racemose branching. The individual polyp has the essential structure of a scyphistoma, but differs in that the taenioles are much more numerous than 4 and that the sexual elements develop in the mesenteries. The strobilation, similar to that of the Discomedusae, is described in some detail. The sexual elements found in the polyp seem to degenerate completely, and the gonad develops de novo in the medusa. The author is of opinion that *Stephanoscyphus* represents an ancestral type of scyphopolyp, and that the latter as seen in the Discomedusae is a degenerate form. The scyphopolyp seems to differ from the anthopolyp as widely as from the hydropolyp. Author.

544. Studies on Reptilian Chromosomes. IV. Chromosomes of *Takydromus* spp. (lizards). K. NAKAMURA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 5 (1935), 341–353.] — The chromosome-complexes of the males of the three species of *Takydromus* are very much alike and are practically identical with those of other lacertids. The chromosomes are 38 in number, of which one pair is minute and dot-like, while the remaining 18 pairs are rod-like and graded in size. The sex chromosomes are a pair of short rod-like chromosomes consisting of two X's which go in division into the resulting spermatids. The males of these lizards are, accordingly, homogametic. Author.

545. Studies on Reptilian Chromosomes. V. Chromosomes of *Japalura swinhonis* (a lizard). K. NAKAMURA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 5 (1935), 355–360.] — The chromosome-complex of the male of *Japalura swinhonis* consists of 46 chromosomes, consisting of 22 rod-like chromosomes of graded size, two very short rod-like or oval ones and 22 dot-like ones. Each of the XX sex-chromosomes goes in the maturation divisions into each resulting spermatid. Accordingly, the male of this lizard is homogametic. Author.

546. Studies on Reptilian Chromosomes. VI. Chromosomes of Some Snakes. K. NAKAMURA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 5 (1935), 361–402.] — Observations on the male chromosome-complexes of 13 species of snakes belonging to Colubridae and Viperidae, 10 V's+6 R's+20 D's=36 seems to be the fundamental formula for these two families. In most snakes, the chromosomes are dimorphic and may be classified into macro- and micro-chromosomes. In some snakes, however, they are polymorphic, i. e., the division into two classes is less clear-cut. The chromosomes of reptiles can be reduced to three types, V- and J-shaped, rod-like and dot-like ones. In the first maturation division the V- and J-shaped chromosomes form multiple-ring tetrads of the shape of V, J or X; the rod-like chromosomes form multiple-ring, single-ring or bipartite tetrads and the dot-like chromosomes form bipartite or dot-like tetrads. In the second maturation division, the dyads appear in the shape of double V's,

bipartites or dots. In the sea-snake, *Laticauda semifasciata*, the V-shaped chromosomes form tetrads of vertical rings and irregularly crooked rods. The rod-like chromosomes form diaschistic rod-tetrads with spindle-fiber attachment at both ends and vertical rings or diamond-shaped tetrads which can be identified with the diaschistic rod-tetrads and double crosses of the early anaphase. The dyads, however, do not differ in structure from those of other reptiles. The sex-chromosomes of snakes are of the XX-type, so that the males are homogametic. Concerning the prototype of the reptilian chromosome-complex, it may be surmised that the original complex consists of 24 V-shaped chromosomes and the complexes of higher groups, such as recent reptiles, birds and mammals, have developed from this type by the dissociation of the arms of the V's.

Author.

547. Les jeunes Physalies. Note supplémentaire sur le Développement post-embryonnaire de la Physalie. Y. K. OKADA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **10**, No. 5 (1935), 407–410.] — A very young 'siphonule' stage of *Physalia* is described. Huxley's figures of this and later stages are more true to nature than Haeckel's. T. Komai.

Abstracts

548. Hepatektomie und Blutbilirubin beim Hunde. (Japanisch.) Genji FUSE. [Tokyo Igk. Z., **47** (1933), 27-188, 3 Textfig. u. 173 Tab.] — Verfasser durchführte eine eigene zuverlässige Hepatektomie nach Sakurai-Fuse-Okuta, d. h. eine modifizierte Methode von Firor und Stinson unter Anwendung der Pyrexglaskanüle, bei mehreren Hunden in Lokalanästhesie und das Blutbilirubin nach Hijmans van den Bergh bis zu ihrem Tode stündlich untersuchen.

O. Mori.

549. Studien über das Pankreas. I. Experimentelle Studien über die Innervation der äusseren Sekretion des Pankreas. (Japanisch.) Minoru FUJII. [Tokyo Igk. Z., **47** (1933), 1249-1290, 4 Textfig. u. 10 Tab.] — Im Pankreasgewebe des Hundes wies der Verfasser die feinen markhaltigen Nervenfasern nach, die nicht von den Vagi abstammen. Er ist der Ansicht, dass in diesen Nervenfasern ausser sensiblen Fasern noch die spinalparasympathischen Nervenfasern gemischt vorhanden sind. Weiter durchführte man mehrere experimentelle Studien, um die Innervation der äusseren Sekretion des Pankreas klar zu machen. O. Mori.

550. Studien über das Pankreas. II. Experimentelle Studien über die Innervation der Bewegung des Ausführungsganges des Pankreas. (Japanisch.) Minoru FUJII. [Tokyo Igk. Z., **47** (1933), 1449-1481, 1 Textfig. u. 10 Tab.] — Der Verfasser stellte Experimente mittels Durchströmungsmethode am Hunde an über die Motilität und die Innervation des Ausführungsganges des Pankreas und bestätigte dabei in der Wand des Ausführungsganges glatte Muskelfasern und elastische Fasern. O. Mori.

551. Über die Bedeutung der Tonusschwankungen, die am Schildkrötenherzen in die Erscheinung treten, und ihre Pharmakologie. (Japanisch.) Kôsuke FURUTA. [Tokyo Igk. Z., **48** (1934), 101-155, 1 Taf., 63 Textfig. u. 1 Tab.] O. Mori.

552. Über die Wirkungen des Strychnins, des Thebains und des Hydrokotarnins, die am isolierten Skelettmuskel der Kröte beobachtet werden. (Japanisch.) Kôtaro FUZITA. [Tokyo Igk. Z., **48** (1934), 156-167, 10 Textfig.] O. Mori.

553. Über den Einfluss der wiederholten Kältereize auf die Mäuse. (Japanisch.) Takeo YAMADA. [Tokyo Igk. Z., **48** (1934), 2052-2073, 8 Textfig. u. 19 Tab.] — Wenn die warmblütigen Tiere der Kälte ausgesetzt werden, reizt das Wärmeregulationszentrum derselben autonom-nervös die willkürlichen Muskeln und lässt sie sich an der chemischen Wärmeregulation beteiligen. Andererseits nach Untersuchungsresultaten lassen die mässigen wiederholten autonomnervösen Reize den Tieren die willkürlichen Muskeln hypertrophieren. Daraus fällt einem eine Idee ein, dass die mässigen wiederholten Kältereize den Tieren die willkürlichen Muskeln werden hypertrophieren lassen. Um sich dies zu überzeugen, unternahm der Verfasser mit vielen jungen Mäusen die folgenden Versuchsreihen: 1. täglich einigemal 5 Minuten lang die mit Eisstückchen gefüllte Metallröhre um den Hals der Tiere anzulegen, 2. tägl. einmal 40 Minuten bis 1 Stunde lang sie im Eisschrank loszulassen und endlich 3. tägl. einmal 20 bis 30 Minuten lang sie im Gefäss loszulassen, das mit Gemisch von Eis u. Kochsalz umgeben und mit abgekühlter Luft gut gelüftet wurde. In dem der Verfasser jeden Versuch 11 bis 17 Wochen lang ausführte, beobachtete er ihre Entwicklung (Körpergewicht), ihre Mortalität und das Gewicht des M. gastrocnemius derselben (nach Tod gemessen). Die erhaltenen Resultate verneinten scheinbar die vorliegende Vorstellung; aber es rührt davon her, dass die Kälte stärker schädigend gegen die Entwicklung der Mäuse wirkte, als sie den Mäusen die Muskeln hypertrophieren liess. Man glaubt daran, dass dies Experimente an anderen geeigneten Tieren erwartete Resultate bringen werden.

O. Mori.

554. Beiträge zur Wirkung des Strychnins auf das Krötenherz. (Japanisch.) Jûro UEDA. [Tokyo Igk. Z., **48** (1934), 2456-2469, 1 Taf. u. 13 Textfig.] O. Mori.

555. On the Shell-fish Sanitation. (Japanese.) Yuzo TOYAMA. [Jikken Ig. Z., **17** (1933), 1340-1349, 5 Tab.] O. Mori.

556. Experimentelle Untersuchungen über die Immunisierungsmethode von Diphtherie des Pferdes. (Japanisch.) Kamajiro YOKOI. [Jikken Ig. Z., **18** (1934), 647-664, 14 Tab.] O. Mori.

557. Untersuchungen über die hämolytische Funktion und den Toxicationsmechanismus des Schlangengiftes. (Japanisch.) Seigo HOSOYA, Shigeru TANI u. Tetsunosuke TANAKA. [Jikken Ig. Z., **18** (1934), 674-693, 21 Tab.] O. Mori.

558. Die heterogene Transplantation des Myxoedoms der Hühner. I. Mitt. (Japanisch.) Shigeyasu AMANO. [Kyoto Ig. Z., **30** (1933), 185-199.] - Histologische Befunde der unter die Haut der weissen Ratten transplantierten Myxoedemgewebe der Hühner nach 2, 4 und 5 Wochen. O. Mori.

559. Über die Einflüsse der aus den im Schatten getrockneten Tieren hergestellten Medikamente auf das Herz des Frosches. (Japanisch.) Sakae HIGUCHI. [Kyoto Ig. Z., **30** (1933), 998-1002, 7 Textfig. u. 1 Tab.] - Der Verfasser herstellte Extrakte einiger im Schatten getrockneten Tieren (Fangheuschrecke, Tausendfuss, Magotaromushi, Wassersalamander und *Rana temporaria*), welche von der älteren Zeit in Japan als Volksmittel bekannt sind. Er verdünnte sie in einer 20fachen Ringer'schen Lösung und injizierte nach kurzzeitiger Erwärmung, Filtrierung und Neutralisierung in das extrahierte Herz des mittelgrossen Frosches. Die Extrakte von Salamander und Fangheuschrecke erregen die Funktion des Herzens ziemlich stark, dieselben von Rana und Magotaromushi leichtgradig und die von Tausendfuss verursacht den unregelmässigen Puls. O. Mori.

560. Über die Temperaturbestimmung des Kaninchens und des Meerschweinchens. (Japanisch.) Sakae HIGUCHI u. Masaichi KINOSHITA. [Kyoto Ig. Z., **31** (1934), 186-197, 4 Tab. u. 18 Textfig.] O. Mori.

561. Über Knochenveränderungen des jungen Kaninchens nach der künstlichen Gallenfistelbildung. (Japanisch.) Shinichi SETA u. Hirotake KAGAWA. [Osaka Igk. Z., **32** (1933), 475-482, 1 Taf. u. 7 Textfig.] — Bei den jungen Kaninchen wurde die künstliche Gallengangsfistel angestellt und die Galle abgeflossen. Dann bemerkt man deutliches Acidosis in dem Skelettsystem der Tiere. O. Mori.

562. Biochemical Studies on the Venom of *Agkistrodon Blomhoffii*, Boie. (Japanese.) Chokuro KOBAYASHI. [Osaka Igk. Z., **32** (1933), 3643-3654, 12 Tab.] — Studies on the hämolysical action of the Agkistrodon poison. O. Mori.

563. Über die Einflüsse der Medikamente auf die Bewegungsvorgänge in der Netzhaut des Hahnauges. (Japanisch.) Takashi MATSUURA. [Okayama Igk. Z., **45** (1933), 1081-1092.] — Der Verfasser berichte früher, wie die physiologischen Bewegungsvorgänge in der Retina des Froschauges und die physiol. Veränderungen der mit Toluidinblau färbbaren Substanz durch verschiedene Medikamente (HNO_3, HCl, KOH, NaOH, Kochsalzlösung, H_2O_2, cholsaures Natrium, Pilocarpin, Atropin, Adrenalin, Cocain, Eselin, Tetrodotoxin, Strichnin, Santonin, Chinin, KCN) beeinflusst werden. Diesmal hat er die bei der Injektion von verschiedenen Medikamenten eintretenden Veränderungen der Bewegungsvorgänge in der Retina des Hahnes untersucht, in welcher die Innenglieder der Stäbchen auffällige Formveränderungen zeigten. Er kam fast zu den gleichen Resultaten wie beim Frosch. Die Einflüsse von Medikamenten auf die physiologischen Bewegungsvorgänge in der Retina des Hahnes sind geringer als in der des Frosches. Näheres findet man in Text mit einem deutschen Referat. O. Mori.

564. Veränderungen der Netzhaut nach dem Tode. (Japanisch.) Takashi MATSUURA. [Okayama Igk. Z., **45** (1933), 1731-1750.] — Die Veränderungen der Netzhaut nach dem

Tode sind nach den Tierarten sehr verschieden. Der Verfasser bediente sich des Frosches und Hahnes als Versuchsmaterial und legte sie gleich nach Dekapitation in physiologische Kochsalzlösung, wonach sie in einer Zimmertemperatur von etwa 20°–24°C liegen blieben. Einige Minuten nach der Dekapitation zeigt jedes Element seine eigene Veränderung. Die Veränderungen, die man 8 Minuten nach der Dekapitation beim Hahn und ebenso beim Frosch 20 Minuten nach der Dekapitation beobachtet, sind ganz verschieden von den respect. Zuständen, die man sofort nach der Dekapitation findet. Näheres siehe man Text mit einem deutschen Referat. O. Mori.

565. On the Action of Electricity on Organisms. I. Rep. On the Action of Electric Current upon *Paramaecium*, Especially on the Cause of Death by Electric Shock. (Japanese.) Nobutane MORI. [Okayama Igk. Z., **46** (1934), 1498–1513, 6 text-figs. and 3 tabs.] — The experiments were carried out in the small pool with electrode upon slide-glass. The results are as follows. 1) Strength-duration curve of the electrical stimulation for *Paramaecium* coincides very well to the rectangular hyperbola i. e., it follows to the excitation law for the muscle or nerve of frog. 2) Not only the slightest excitation of *Paramaecium* but also the death by electrical shock follows to this rule. 3) The cause of death by electrical shock appears to be alkalinity in the neighbourhood of the cathode pole. 4) Alternating current, if its interval is short enough for the intensity of the current, does not stimulate *Paramaecium* or not cause death. 5) But alternating current, if rectified, even high frequency-current like Tesla causes excitation or death of *Paramaecium*. O. Mori.

566. Über den Bau und die Sehfähigkeit des Facettenauges einer Libelle, *Orthetrum albistylum* Sely's. (Japanisch.) Nobutane MORI. [Okayama Igk. Z., **46** (1934), 1855–1871, 4 Taf., 5 Textfig. u. 4 Tab.] — Verfasser untersuchte das Facettenauge einer Libelle histologisch sowie auch optisch und gelangte zu folgendem Schluss. 1) Die Form eines Facettenauges ist eiförmig. Es besteht aus ungefähr 7888 Ommen. Der Gesichtswinkel eines Facettenauges betrug bei natürlicher Körperlage 163° im horizontalen Meridian und 162° im vertikalen. 2) Ein Facettenauge besteht aus Hornhaut; Kristallkegel; Kegel, der zwischen Kristallkegel und Sehzelle liegt; Sehzellen und Nervenfasern. 3) Eine Sehzelle verbindet sich mit nur einer Nervenfaser. Die weitere Verkettung der Nervenfasern im Ganglion geschieht wie in unserer Netzhaut. Daraus kann man wohl entnehmen, dass die Netzhaut der höheren Tiere einem Teile des Gehirnes entspricht. 4) Der Kegel, der zwischen Kristallkegel und Sehzelle liegt, wirft das Licht an der Grenze zwischen dem Kegel und der ihn umgebenden leeren Röhren zurück. 5) Wenn man dieses Facettenauge vor das Fenster stellt und mit der Lupe beobachtet, so sieht man ein verkleinertes vollkommenes Fensterbild, aber nicht ein Teilbild desselben an jeder Hornhaut der Ommen. 6) Die Bestimmung des Krümmungsradius und des Brechungsindices der Hornhaut ermöglicht es, die Brennweite des optischen Apparates dieses Auges zu berechnen. Der hintere Brennpunkt liegt durchschnittlich 0,08 mm hinter der Hornhaut. Diese Stelle entspricht ungefähr dem distalen Ende des Kegels, welcher zwischen Kristallkegel und Sehzelle liegt. Unter diesen Verhältnissen fällt das optische Bild jedes Objektes in der Aussenwelt auf jede Sehzelle, welche sich mit nur je einer Nervenfaser verbindet. Man kann wohl vermuten, dass ein solchen Auge nicht die Details des Bildes, sondern nur die Grösse, ungefähre Gestalt und die Richtung des Objektes durch die Zahl und Verteilung der erregten Sehzellen erkennen kann. O. Mori.

567. Über die Wirkung des Giftes der *Naja naja atra* auf das isolierte Froschherz. II. Mitt. Jahreszeitliche Schwankungen der Resistenz des Froschherzens gegen das Kobragift. (Japanisch.) Tsutomu NAKAMURA. [Taiwan Igk. Z., **33** (1934), 207–211, 2 Tab. u. 1 Textfig.] — Die Resistenz des Froschherzens gegen das Kobragift ist im Herbst schwächer als im Sommer. In einer derselben Jahreszeit ist sie bei *Rana plancyi* und *Rana narina* schwächer als bei *Rana rugulosa*. O. Mori.

568. Über die Widerstandsfähigkeit der Manguste gegen Schlangengift. (Japanisch.) Chikashi SUZUKI, Kazuo MATSUMOTO u. Kazushi SUGIO. [Taiwan Igk. Z., **33** (1934), 305–314, 9 Tab.] — Die Widerstandsfähigkeit der Manguste gegen das getrocknete Gift der 5 in Formosa einheimischen Schlangenarten. Die minimale Menge, welche nötig ist, eine Manguste mit der Körpergewicht 400 g zu töten, ist bei: *Naja naja atra* 0.064300 g, *Trimeresurus mucro-*

squamatus 0.02035 g, *Ancistrodon acutus* 0.022033 g, *Bungarus multicinctus* 0.000555 g und *Trimeresurus gramineus* 0.013500 g. Ausserdem wurde die Widerstandsfähigkeit der Mauguste wurde mit derselben des Kaninchens und des Meerschweinchens vergleicht. O. Mori.

569. *Paederus idae* Lewis in Formosa und Dermatitis infolge seines Giftes. (Japanisch.) Saichi MIYAMOTO. [Taiwan Igk. 7., **33** (1934), 1 Taf. u. 5 Tab.] O. Mori.

570. Auswertung der Digitalis-präparate (Focke'scher Wert) mit Benützung der formosanischen *Rana tigrina* Daudin an Stelle der japanischen *Rana nigromaculata* Hallowell. (Japanisch.) Bun KO. [Taiwan Igk. Z., **33** (1934), 1666-1691, 22 Tab.] O. Mori.

571. Über eine *Bodo*-art im Süsswasser der Stadt Kumamoto. (Japanisch.) Tokichi ROKUTANDA. [Kumamoto Igk. Z., **9** (1933), 129-138, 1 Taf. u. 1 Textfig.] — Beim Versuch über die Wasserspirillen aus dem Süsswasser der Stadt Kumamoto, Japan, fand der Verfasser eine bisher nichts beschriebene zweigeisselige Flagellatenart, welche am besten dem *Bodo asiaticus* ähnlich sind. Darüber wurden genaue morphologische und biologische Untersuchungen durchgeführt. O. Mori.

572. Einfluss der Giftes von *Trimeresurus flavoviridis* Hall auf verschiedene Organe. I. Befunde bei der Leber. (Japanisch.) Mitsuo FUKUDA. [Kumamoto Igk. Z., **10** (1934), 661-673, 1 Taf. u. 3 Tab.] — Den Kaninchen wurden entweder nur einmal Letaldosis, oder dauernd das 0.1%ige Gift und die 4%ige Carminlösung injiziert. Nach den histologischen Untersuchungen fand man folgendes: 1) Die Kupfferschen Zellen werden, infolge steigender Funktion, beträchtlich grösser und speichern die Carminkörner verschiedener Grösse. 2) Die Granula und Stäbchen der Plastosomen in den Leberzellen werden feiner und bei der dauernd injizierten Leber liegen sie gegen den Kern symmetrisch. 3) Die Sekretgranula der Leberzellen nehmen stets beträchtlich ab: diese Tatsache zeigt die Verminderung der Gallenbildung. 4) Der Golgische Binnennetzapparat der Leberzellen magert ab und wird einfacher. 5) Die Glykogen und Neutralfette zeigen keine bemerkbare Mengenabweichung. O. Mori

573. Über den Einfluss von *Paederus idae* Lewis auf das Auge. (Japanisch.) Kurayoshi TAKASAKI. [Nihon Gankwa. Gk. Z., **37** (1933), 154-164, 8 Textfig.] - Das Gift des in Kyushu, besonders in Kumamoto, im Sommer und im Frühherbst herumfliegenden Insekts (*Paederus idae* Lewis) wirkt auf die Menschen schädigend ein. Wenn das Insekt sich in den Konjunktivasack verirrt, eindringt oder an den vorderen Abschnitt des Auges stösst, so entsteht eine akute Konjunktivitis mit Dermatitis linealis des Augenlides. O. Mori.

574. Über die Augenveränderung durch *Paederus idae* Lewis. IV. Mitt. (Japanisch.) Kurayoshi TAKASAKI. [Nihon Ganka Gk. Z., **38** (1934), 1795-1803, 3 Textfig. u. 4 Tab.] — Diesmal studierte man den Einfluss des Kantaridins, welches dem Gifte von *Paederus idae* sehr ähnlich ist und in Japan im Körper von *Epicaute Gorhami* oder Meloe gefunden wird, auf das Kaninchenauge O. Mori.

575. Über den Lichtsinn und Farbensinn des Fisches. II. Der Rheotropismus als Prüfungsmethode. (Japanisch.) Shigeru KAGOSHIMA u. Ki YOSHIMURA. [Nihon Gankwa Gk. Z., **38** (1934), Sitzungsber. d. 38. Versammel., 661-674, 2 Textfig.] — Bei der Forschung benutzten die Verfasser den Rheotropismus als Prüfungsmethode, welcher abgesehen vom Phototropismus der einzige durch gesichtliche Reize zu erregende Tropismus ist. Dazu berücksichtigten sie die Helligkeit der Farbe und die Adaptationszustände des Fisches. Das Prinzip der Methode war den Fischen im grossen Fischbehälter die Wahrnehmungen zu geben, als ob sie im Strome gezogen sein, und den dabei aufgetretenen Rheotropismus unter mehreren Bedingungen zu untersuchen. Die Ergebnisse der Untersuchung sind folgendermassen zusammen gefasst: 1) Die Zeit der Helladaptation des Fisches betrug 3′10″ bis 9′25″, durchschnittlich 5′20″. 2) Die Zeit der Dunkeladaptation des Fisches war 55″ bis 4′07″, durchschnittlich 2′ 20″. 3) Je kleiner die Differenz zwischen beiden Zuständen, desto kürzer die Adaptationszeit.

4) Trotz der besonderen Einrichtung konnte man keinen positiven Nachweiss über den Farbensinn des Fisches finden. O. Mori.

576. The Behaviour of the Skin towards Solutions of Various Kinds and Various Concentrations. Part 3. Is the Change of the Normal Skin in Weight Influenced by the Temperature of the Solutions ? (Japanese.) Eiichi NISHIMURA. [Jap. J. of Dermat., **33** (1933), 34–52, 17 text-figs. and 72 tabs.] — Pieces of normal dorsal skin of healthy adult male rabbits were soaked into each of the 0.2 N and 0.1 N solutions of KCl, NaCl, LiCl, $CaCl_2$, $MgCl_2$, $BaCl_2$, KI, KBr, KNO_3, K_2CO_3, K_2SO_4 at 0°, 18° and 37°C. The swelling of the skin in the solutions cited above was a limited one except for that at 37°C. The rate of swelling lessened with the rising of the temperature of the solutions. The swelling at 0°C therefore, was the largest and that at 37°C was the smallest. The lessening of the rate of swelling might be due partly to the coagulatioı of albumen, but mostly to the increased loss of albumen and salts in the solution. O. Mori.

577. The Behaviour of the Skin towards Solution of Various Kinds and Various Concentrations. Part 4. The Examination of the Swelling of a few Pathological Skins. (Japanese.) Eiichi NISHIMURA. [Jap. J. of Dermat., **33** (1933), 204–225, 19 text-figs. and 51 tabs.] — The skins used were an artificial eczematous dermatitis caused by an application of croton-oil, the epilated back of male adult rabbits, a sarcoma of skin caused by an injection of emulsion rabbit sarcoma and a piece of carcinoma of human penis. The solutions used were those of 0.2 N of KCl, NaCl, LiCl, $CaCl_2$, $MgCl_2$, $BaCl_2$, KI, KBr, KNO_3, K_2CO_3, K_2SO_4 at 0°C. O. Mori.

578. Entwicklungsgeschichtliche Untersuchungen über die früheren Entwicklung der Eizellen des Kaninchens im Ovarium und nach der Ovulation. (Japanisch.) Kwanichiro TAKEUCHI. [Kaibô Z., Tokyo, **6** (1933), 1-49, 7 Taf. u. 2 Tab.] O. Mori.

579. Über die strukturellen Veränderungen des Pankreas nach Unterbindung des Ausführungsganges, besonders über die Form des Golgischen Apparates in den Langerhansschen Inselzellen. (Japanisch.) Shinsaku YAGI u. Kenbun KUGA. [Kaibô Z., Tokyo, **6** (1933), 563-576, 2 Taf.] O. Mori.

580. Beitrag zur Kenntnis des Giftes von *Trimeresurus okinavensis*. (Japanisch.) Toshio OTSUKA. [Kyoto Ikwadaigaku Z., **9** (1933), 77-86.] — Mit der Gift von *Trimeresurus okinavensis* kann man gewisse Veränderungen betreffs des quantitativen Wertes der Formbestandteile des Kaninchenblutes. Dabei schwankt die Menge der Leukozyten am stärksten, die der Thrombozyten mittelstark und die der Erythrozyten am schwächsten. Der Veränderungsgrad der Erythrozyten und Thrombozyten geht parallel mit der Injektionsmenge des Giftes, wogegen der von Leukozyten sich entgegengesetzt bewegt. Durch Erhitzung des Schlangengiftes bis zu einem gewissen Grade wird die Wirkung auf die Blutzellen des Kaninchens abgeschwächt oder verschwindet. O. Mori.

581. Experimentelle Untersuchung über die Einfluss der Röntgenbestrahlung auf die Entwicklung des männlichen sekundären Geschlechtszeichens der Hühner. (Japanisch.) Jinjiro SUZUKI. [Tohoku Ig. Z., **16** (1933), 1-6, 2 Tab.] — Bei den ausgewachsenen Hühner werden die allen Geschlechtszellen mit der Ausnahme der Sertoli'schen Zellen zerstört und das Interstitium wurde gewuchert. Man bemerkt im allgemeinen nicht besondere Veränderungen in den sekundären Geschlechtszeichen. Bei den jungen Hühner wurde die Entwicklung des Hodens bedeutend unterdrückt. In 12. Monaten nach der Geburt sieht deı Bau des Hodens bei den bestrahlten Vögeln noch wie ein Embryo aus. Die sekundären Geschlechtszeichen sind auch ziemlich bedeutend beeinflusst. Die Hahnenkämme sind nicht gut entwickelt und die Vögeln handeln sich nicht wie ein Hahn. O. Mori.

582. Zwei Fälle der Geschwülste der Ratte. (Japanisch.) Kaku YASUMOTO. [Acta Dermat., **21** (1933), 453-358, 1 Taf.] — Bei Ratte wurden ein Fall von Riesenzellensarkom und ein Fall von Spindelzellensarkom gefunden. Die Transplantation beider Geschwülste war in die

andere Ratte positiv und in Kaninchen negativ. O. Mori.

583. **Über das die Fischschuppe durchlassende Licht.** (Japanisch.) Noboru SATÔ. [Acta Dermat., 22 (1934), 115–118, 3 Taf.] — Die Durchlässlichkeit des Lichtes von Quecksilberquarzlampe durch die frisch abgeschabenen Schuppen des Karpfens und der Karausche. Sie durchlassen am besten die Strahlen mit kürzeren Wellenlängen im visiblen Teil und die Strahlen im Anfangsteil der Extraviolettstrahlen. Die anderartigen Strahlen wurden mehr od. weniger resorbiert. Besonders bemerkbar ist, dass die Rückenschuppen des Karpfens und die Bauchschuppen der Karausche fast alle Menge der kurzwelligen Strahlen unter 2900 Å resorbieren.
O. Mori.

584. **Experimentelle Untersuchung über die Giftigkeit der Auster in der Laichzeit.** (Japanisch.) Mitsugu KURAMOTO. [Gun-I. Z., 235 (1934), 985–1002, 2 Textfig. u. 16 Tab.] — Der Verfasser erzeugte Extrakte aus Eier und Sperma von *Ostrea gigas* Thunberg in der höchsten Laichzeit (Juni bis August) und Nichtlaichzeit, aus Laichgewebe in Nichtlaichzeit und als Kontrolle aus übrigen Körperteilen. Als er diese verschiedenen Extrakte in die Bauchhöhle oder Schwanzvenen der Mäuse injiziert, wirkte der Extrakt aus Erzeugungszellen bei geringster Menge tödlich, aber die anderen nicht, soweit er nicht viel grössere Menge injizierte. Diese Giftigkeit wird mit Kaninchen-Immuniserum vermindert und verschwindet beinahe durch 30 Minuten Erwärmung in 57°C. Man konnte aber nicht die Giftigkeit wahrnehmen, als man Kaninchen täglich 20–30 g von gemahlener Auster 10 Tage lang fütterte. O. Mori.

585. **Pigment-production of *Bacillus pyocyaneus* and *B. prodigiosus* on Agar Media Composed of Meckerel or Bean-cake.** (Japanese.) Kiyoshi FUKUMOTO. [Manshu Ig. Z., 21 (1934), 203–210 6 tabs.] O. Mori.

586. **Die Agglutination- und Hämolysenwirkung des Aalblutes gegen die autogenen und homogenen Blutzellen.** (Japanisch.) Kazuo ECHIGO. [Juzenkwai Z., 38 (1933), 1974–2001, 17 Tab. u. 2350–2364, m. 10 Tab.] O. Mori.

587. **Serologische Untersuchungen des Aalblutes.** (Japanisch.) Kazuo ECHIGO. (Juzenkai Z., 38 (1933), 2620–2644, 21 Tab.] O. Mori.

588. **Über den Einfluss der intraperitonealen Injektion von Heteroserum auf das Leukozytenbild der weissen Ratte.** (Japanisch.) Masakatsu KAGEYAMA. [Aichi Igk. Z., 41 (1934), 1923–1947, 4 Textfig. u. 14 Tab.] — Den weissen Ratten wurde aus Pferd, Hund, Kaninchen, Huhn, Alligatorschildkröte und Karausche stammende Heteroserum in die Bauchhöhe injiziert. Im allgemeinen bemerkt man danach typische Veränderung im Leukozytenbild. Kurz nach der Injektion vermindern sich die Leukozyten transitorisch. Dann vermehren sie sich, doch kommt die Leukozytenzahl in 1–2 Tage nach der Injektion zu dem normalen Zustand wieder. Im Stadium der Vermehrung findet man im Blut der weissen Ratten eine bedeutende Zunahme der neutrophilen Leukozyten, eine deutliche Linksverschiebung der Kerntypus d. h. die durchschnittliche Vermehrung der Kernlappenzahl und die geringere Schwankung der Lymphozytenzahl. Die Tatsachen sprechen für die Erregung der blutbildenden Funktion des Knochenmarks.
O. Mori.

589. **Über die Bluttypen der *Uroloncha domestica* betrachtet vom Standpunkt der menschlichen Blutgruppen.** (Japanisch.) Shizuka ITÔ. [Aichi Igk. Z., 41 (1934), 1956–1963, 5 Tab.] — Der Verfasser feststellte 2 Bluttypen im Blut der *Uroloncha domestica*. Der erste Typus entspricht AB Typus und der zweite A Typus beim Menschenblut. In 113 Vögeln treten die beiden Typen in Verhältnis: AB Typus 1.5: A typus 8.5. O. Mori.

590. **Biochemical Studies in Hibernation. I and II.** (Japanese.) Tokusaburo YAZAWA. [Seiikwai Z., 53 (1934), 465–509, 14 text-figs. and 33 tabs.] — In the first report was studied the reduced glutathione contents of the organ tissues of *Rana nigromaculata* observed throughout all season, and in the second report the metabolism in the muscle of *Rana nigromaculata*.
O. Mori.

591. Über die Beziehung der Serumoberflächenspannung zum Wachstum des Kaninchensarkoms. I, II u. III. (Japanisch.) Koichi MIYAMA. [Seiikwai Z., **53** (1934), 558–613, 27 Textfig. u. 145 Tab.] — In der ersten Mitteilung wurde über die Oberflächenspannung des Sarkomkaninchenserums studiert, in der zweiten über den Einfluss der Kastration auf das Wachstum des Kaninchensarkoms und auf die Oberflächenspannung des Kaninchenserums, und in der dritten Mitteilung über den Einfluss der Schwangerschaft auf das Wachstum des Kaninchensarkoms und auf die Oberflächenspannung des Kaninchenserums. O. Mori.

592. Die Fermente des Kaninchensarkoms. (Japanisch.) Koichi MIYAMA. [Seiikwai Z., **53** (1934), 819–837, 27 Tab.] — Der Verfasser konnte von dem nekrotisierten und nicht nekrotisierten Teile des Hühnersarkoms ziemlich viel Amylase und Lipase extrahieren. O. Mori.

593. Zur Kenntnis des Paederus-giftes. II. Mitt. (Japanisch.) Yoshio ITO. [Fukuoka Ikwadaigaku Z., **26** (1933), 162–186, 3 Textfig. u. 11 Tab.] — Zur Untersuchung gewähltes Gift stammt aus *Paederus idae* Scharp, Staphylinidae, Coleoptera. Das Käfergift enthält weder Ameisensäure noch Salicylsäure, sondern einen cantharidinähnlichen Stoff. Die chemische und biologische Eigenschaft des Giftes, welches einerseits mit Chloroform, Aether oder Alkohol, anderseits mit NaCl-lösung extrahiert wurde, wurden genau untersucht. O. Mori.

594. Zur Kenntnis des Paedurus-Giftes. III. Mitt. (Japanisch.) Yoshio ITO. [Fukuoka Ikwadaigaku Z., **26** (1933), 1240–1259, 7 Textfig.] — In dieser Mitteilung wurden die Ergebnisse über die klinischen und histologischen Veränderungen an der Menschen- und Tier- (Meerschweinchen und Kaninchen) haut durch die subkutane Einspritzung des Paedurus-Giftes berichtet. O. Mori.

595. Zur Kenntnis des Paedurus-Giftes. IV u. V. Mitt. (Japanisch.) Yoshio ITO. [Fukuoka Ikwadaigaku Z., **27** (1934), 1205–1260, 12 Textfig. u. 20 Tab.] O. Mori.

596. Über die myogene Automatie des Limulusherzens. (Japanisch.) Nobuo HOSHINO u. Sensuke KAKEI. [Fukuoka Ikwadaigaku Z., **26** (1933), 622–636.] — Zunächst wurden 5 Limulusherzen histologisch in Serienschnitten untersucht. Die Ganglienzellen waren nur innerhalb des medianen Nervenstrangs vorhanden und konnten in 3 Gruppen je nach der Grosse und Form eingeteilt wurden, während die topographische Verteilung der einzelnen Gruppen verschieden war. Dann wurden die vorsichtigen Experimente über die Automatie wurden entweder an der vorderen oder hinteren Herzsegmente vorgenommen. Aus den Ergebnissen nimmt der Verfasser an, dass nach Lostrennung des medianen Nervenstrangs peristaltische Bewegungen auftreten können, und dass die myogene Reizbildung und Reizleitung des Limulusherzens nicht abzuweisen sind. O. Mori.

597. Ist das Spinnengewebe schädlich dem Menschenauge ? (Japanisch.) Go Kô KI. [Chûô Gankwa Ihô, **25** (1933), 635. Sitzungsber.] — Experimentell bestätigte man, dass das Spinnengewebe keine Schädlichkeit gegen das Menschenauge ausübt. O. Mori.

598. Die Störungen der Auge durch den Bienenstich. (Japanisch.) Minoru SUMIYA. [Jikken Ganka Z., **15** (1932), 136.] O. Mori.

599. Über den Kreatin-, Eisen- und Fettgehalt der Muskulatur von Fischen. (Japanisch.) Sukeshiro NAMIKI. [The Nagoya Journal of Medical Science, **7** (1934), 206–207.] — Im gewöhnlichen Fleisch von Makrele, Bonito, Karpfen und *Trachurus japonicus* findet sich Kreatinmenge wie in der weissen Muskulatur des Kaninchens und ungefähr 2mal soviel Kreatin wie im roten. Der Kreatiningehalt zeigt keine Unterschiede in beiden Fleischarten. Dagegen übertrifft viel mehr das rote Fleisch am Eisen- und Fettgehalt das gewöhnliche. O. Mori.

600. Adenosarkoma der Schweinniere und Adenoma papilliferum der Pferdlungen. (Japanisch.) Masami KATAE. [Chûô Jûik. Z., **46** (1933), 23–26, 2 Taf.] O. Mori.

601. **Untersuchungen über die für die Ärzte und die Tierärzte wichtigen Insekten in Formosa. I. Siphonaptera.** (Japanisch.) Seitoku SUGIMOTO. [Chûo Juik. Z., **46** (1933), 605–632, 2 Taf. u. 6 Tab.] — Untersucht wurden *Pulex irritans* L., *Xenopsylla cheopis* Roth, *Ctenocephalus canis* Curt, *Ct. felis* Bouché, *Ct. musculi* sp. nov., *Leptopsylla musculi* Düges, *Ceratophyllus fasciatus* Bosc., *Ischnapsyllus tateishii*, sp. nov. O. Mori.

602. **Ein Vortrag über den Waschbeerhund (Racoon dog, Japanese dog.)** (Japanisch.) Keikichi YAMAWAKI (Chûô Jûik. Z., **47** (1934). 271–284.] — Die Beschreibungen über die Natur, Form, Haarfarbe und einige Anmerkungen betreffs des Aufbringens und Aufziehens des Waschbeerhundes. O. Mori.

603. **Ein seltener Fall von Nierenanomalie eines Pferdes.** (Deutsch.) Osamu EMOTO u. Shutaro YAMAMOTO. [Nihon Jûi Gk. Z., **13** (1934), 139–142, 1 Taf.] — In dem Falle fand man an der rechten Seite die auffällige Nierenatrophie, die Harnleiterdilatation, die Harnleitermündungsanomalie und die kompensatorische Hypertrophie der linken Niere. O. Mori.

604. **Immunologische Studien des Fischrogeneiereiweisses I u. II.** (Japanisch.) Yoshizo TAKEDA. [Nihon Biseibuts. Z., **27** (1933), 366–383, 12 Tab. u. 423–437, 12 Tab.] — Als Material der Untersuchungen wurden *Pagrosomus major*, *Muraenesox cinereus* Forsk., *Carussius auratus*, *Misgurnus anguillicaudatus* gewählt. O. Mori.

605. **Immunologische Studien des Fischrogeneiereiweisses und des Eiereiweisses anderer Tierklassen.** (Japanisch.) Yoshizo TAKEDA. [Nihon Biseibuts. Z., **27** (1933), 1170–1179, 7 Tab.] — Als Material wurden *Pagrosus major*, *Bufo vulgaris*, *Clemmys japonicus*, *Gallus domesticus* gewählt. Immunologische Spezifität des Fischrogeneiweisses ist beschränkt wirksam nur bei den Fischen und nicht bei den anderen Tierklassen. O. Mori.

606. **Über das serologische Verhalten der Kolloidsubstanz, welche Kröteneier umschliesst.** (Japanisch.) Yoshizo TAKEDA. [Nihon Biseibuts. Z., **27** (1933), 1180–1184, 7 Tab.] — Die Kolloidsubstanz der Kröte ist serologisch mehr ähnlich dem Fleische als den Eiern. O. Mori.

607. **Biologische Studien über das Blut u. insbes. Blutplasma des Sarkomhuhns.** (Japanisch.) Kaoru IIDA. [Nihon Biseibuts. Z., **27** (1933), 1307–1321.] O. Mori.

608. **Über einen Fall der Gallenblasenagenesie beim Meerschweinchen.** (Japanisch.) Kikuo KIDO. [Hokuetsu Igk. Z., **48** (1933), 455–462.] — Bei einem Meerschweinchen wurde der Defekt der Gallenblase und eine leichtgradige Hypertrophie der Wand des Ductus choledocus wahrgenommen. O. Mori.

609. **Experimentelle Untersuchungen über den Einfluss der Kastration von Haushähnen auf die Entwicklung der oberen Luftwege.** (Japanisch.) Jinjiro SUZUKI. [Dainihon Jibi Kh., **39** (1933), 255–286, 1 Taf. u. 3 Tab.] O. Mori.

610. **Experimentelle Untersuchungen über den Einfluss der Röntgenkastration von Haushähnen auf die Entwicklung der oberen Luftwege.** (Japanisch.) Jinjiro SUZUKI. [Dainihon Jibi Kh., **39** (1933), 287–298, 1 Taf.] O. Mori.

611. **Über die Beziehung der Ovulation und die Blutung in der Paarungszeit beim Hunde.** (Japanisch.) Takeo ÔTA. [Kinki Fujin Z., **16** (1933), 1649–1652, 4 Textfig.] — Die Ovulation findet beim Hunde nach der Blutung, d. h. gerade in der Paarungszeit statt. Vor der Blutung ist die Oberfläche des Ovarium glatt und entwickeln die Follikel sich in ihnen nicht ganz reif. Während der Blutung werden die Follikel reif und die Ovarien maulbeerartig. Nach der Blutung bemerkt man an ihrer Oberfläche die Bilder der gesprungenen Follikel. Von der Blutungsperiode bis zu nach der Blutung verdickt die Uterusschleimhaut und wuchern die Uterindrüsen. O. Mori.

612. Einflüsse von Cholesterinfütterung des Hahns auf das Ei. (Japanisch.) Sadaji MIYAMOTO. [Jika Z., **402** (1933), 1911-1916, 1 Taf.] — Die Cholesterinfütterung des Hahns beeinflusst mehr od. weniger auf die Legungszahl, aber gar nicht auf das Gewicht der Eier, die absolute Menge und den Prozentgehalt von Cholesterin, Wassermenge und Trockensubstanzmenge in Eier.

O. Mori.

613. On the Local Variation of the Japanese Sardine, *Sardina melanosticta*, Especially on the Variation of the Number of Vertebrae. (Japanese.) Ikusaku AMEMIYA and others [S. G. H., **6** No. 1 (1934), 1-12.] — Japanese sardine distributes in very wide range from Kyûsyû to Hokkaido in the Pacific as well as in the Japan Sea. The fish does not show any marked local variation externally, yet the result of statistical study reveals that the mean value of the number of vertebrae is lower, although slightly, in the south (warm) district than in the north (cold), that is, in southern Kyûsyu the said value is 50.48, while in Hokkaido 50.72, and those of the intermediate districts show the same tendency. In the Japanese sardine as the whole the number of vertebrae varies from 47 to 53. Of those, the percentage having 47 vertebrae is 0.02, that having 48 0.05, that having 49 0.73, that having 50 35.18, that having 51 60.47, that having 52 3.53 and that having 53 0.02, so that the majority of the Japanese sardine have 51 vertebrae and fish having 50 vertebrae come next. The cause of the local variation, though slight, in the mean value of the number of vertebrae is discussed. The different temperature of the sea-water to which the embryos and larvae of the fish are exposed at different localities seems to act as the chief agent for the variation of the number of vertebrae.

I. Amemiya.

614. On the Prawns Belonging to the Genus *Pandalus*. (Japanese.) Yû YOKOYA. [S. G. H., **6**, No. 1 (1934), 13-17.] — Brief description of prawns belonging to the genus *Pandalus* found in the Japanese waters, i. e., *P. borealis* Kröyer, *P. hispinotus* Brandt, *P. platyceros* Brandt, *P. latirostris* Rathbun and *P. nipponensis* Yokoya. Their distribution and economic importance are also referred. Among them the first species has the most fishery importance, the last distributes in the southernmost waters, while others in rather northern regions I. Amemiya.

615. On the Digestive Tract and the Food of the Fish, *Leuciscus hakonensis* Günther. (Japanese.) Yasuo SUEHIRO. [S. G. H., **6**, No. 2 (1934), 65-70, 3 text-figs.] — The Cyprinoid fish has no stomach, so the digestive tract runs directly from the oesophagus to the anus. The intestine makes loops three times on its course. The fish is omnivorous and its food consists of soft vegetables, water-weeds and some animal matters, such as, annelids, crustaceans and insects — adult and larvae.

I. Amemiya.

616. On the Development of *Paphia philippinarum* (Adams et Reeve). (Japanese.) Itiro MIYASAKI. [S. G. H., **6**, No. 2 (1934), 71-75, 1 pl.] — The egg which measures 63-66 μ in dia. has a thick geratinous coating. The perivitelline space is narrow. The segmentation is total and unequal and there appear two polar bodies, but no polar lobe. The trochophore is attained in about 10 hours after fertilization at 28°C, and the shelled larva in about 17 hours. The shelled larva is coloured in deep purple along the hinge line and deep yellow along the margin of the shell. Developmental stages are well illustrated. I. Amemiya.

617. Biological Study of the Crab, *Neptunus trituberculatus* Miers, with some Notes on the Relation of the Meat Amount and Lunar Phase. (Japanese.) Aizi TAKASIBA. [S. G. H., **6**, No. 2 (1934), 86-96.] — Mating takes place in June to October and the spawning in next May to July. During the interval between the mating and the spawning the female keeps in her body the spermatophore received from the male. Moulting of the shell occurs in June to October, not in winter season. By each moulting the shell adds its size in the rate of 16-22% of previous stage. The author examined 816 individuals obtained in full and new moon periods from April to December and studied statistically their meat amount in relation to lunar phase and came to the conclusion that there is no intimate and definite relation between the lunar phase and meat amount, contrary to the saying that the crab has small amount of meat in the full moon period.

I. Amemiya.

618. On the Development of the Digestive Tract and the Change of Food with it in the Fish, *Chasmichthys gulosus*. (Japanese.) Yasuo SUEHIRO. [S. G. H., **6**, No. 3 (1935), 109–113, 8 text-figs.] — With the growth of the fish the digestive tract changes its construction and also its feeding habit alters. In the very young stage the digestive tract is straight from the oesophagus to the anus and the food consists of micro-organisms. In the adult the digestive tract has two bends and its food consists chiefly of crustaceans. I. Amemiya.

619. Copepods of Sagami Bay. I. Fam. Eucalanidae. (Japanese.) Otohiko TANAKA. [S. G. H., **6**, No. 4 (1935), 142–165, 2 text-figs. and 1 pl.] — Revision and description of copepods belonging to the family Eucalanidae found in Sagami Bay; 9 species of *Eucalanus*, 2 species of *Rhincalanus* and 1 species of *Mecynocera*. All of them are already known species. The author took special care on the copepodid stages of them and examined each species with its immature forms. Thus, he verifies that several species having been described as independent ones are nothing else than certain stages of certain species known beforehand scientifically. I. Amemiya.

620. Copepods of Sagami Bay. II. Fam. Candacidae. (Japanese.) Otohiko TANAKA. [S. G. H., **6**, No. 4 (1935), 210–227, 6 pls.] — Description and revision of species belonging to the Family having the single Genus *Candacia* found in Sagami Bay. 8 species are found mostly in the winter season. They are all already known ones. I. Amemiya.

621. On the Life History of a Fresh Water Gammarus, *Echinogammarus annandalei* found at Niguti. (Japanese.) Sin'iti WATARI. [S. G. H., **6**, No. 4 (1935), 181–209, 7 text-figs.] — The Gammarus is much used as food stuff for trout culture. It lives and breeds vigorously in the cold spring water where water-weeds grow and decaying plant leaves are present on the bottom. Morphology, breeding habits, growth, exhuviation and suitable temperature (12°.C) are studied. It is omnivorous in nature and feeds on fresh and decaying vegetable and animal matters. I. Amemiya.

622. On the Immature Forms of Crustacean Decapods Found in the Vicinity of Misaki Marine Biological Station in the Winter Season. (Japanese.) Yû YOKOYA. [S. G. H., **6**, No. 4 (1935), 228–239, 1 pl.] — Description of zoea and mysis of some Penaeidea, immature forms of some Palaemonidae, Pandalidae and *Amphion*, some larval and immature stages of Thalassinidea, Galatheidea and Dromiacea. I. Amemiya.

623. Studies on the Development of *Penaeus japonicus* Bate. I. Rept. (Japanese with English summary.) Motosaku HUZINAGA. [Report of the Hayatomo Fishery Institute, **1**, No. 1 (1935), 1–51, 16 pls.] — Fertilized eggs spawned by copulated females kept in the coop were obtained, and their development was studied from just after spawning till mysis stage. The egg is spherical, its diameter measuring 0.25–0.30 mm. It is demersal. Its colour being pale yellow matches well that of bottom sand. The egg membrane is colourless and transparent. The perivitelline space is rather narrow. The segmentation is total and equal. The embryo makes embryonal membrane inside the egg membrane. The larva hatches out as a nauplius 13–14 hours after spawning at 29°.C. During the nauplius the larva moults six times, so that there are six substages of nauplius more or less distinct from each other. The zoea is attained in 36–37 hours after hatching. There occur three moultings in the zoea, that is, there are three metamorphic substages in it, and it takes 12–15 days for the whole zoea stage. Then the mysis stage ensues; its first substage measures 2.25 mm in body length and the second 2.80 mm. Although spawned eggs were obtained very abundantly and they almost all developed to attain the nauplius stage as well as the zoea, it was fairly difficult to rear the zoea to get to the mysis; only a small number of the mysis were obtained. The description is very minute throughout the developmental stages which are well illustrated by figures numbering 147. I. Amemiya.

624. Biological and Fishery Research on Japanese King-crab, *Paralithodes camtschatica* (Tilesius). (Japanese with English summary.) Hisatoshi MARUKAWA. [S. S. H., **4** (1933), 1–152, 19 pls.] — The crab is extensively fished in northern waters and used much by can-

neries for the material of Japanese crab-tin. In the present study the author deals with biological aspects on one hand, such as, distribution of the crab, external and internal morphology of its body, breeding, reproduction, development, and feeding habits, and on the other hand from the fisheries points of view he proposes some regulations on fishing gears, fishing seasons, the size of carapace etc. for the protection and conserving of the natural resource. Especially the embryological study in the present work is very far reaching. The author described the developmental process throughout the metamorphosis from the spawning of the egg till the glaucothoë or even the young adult form. All figures in plates are well illustrated. I. Amemiya.

625. Influence of Starvation on the Growth of the Carp, *Cyprinus carpio* L. II. (Japanese with English Abstract.) Yoshiichi MATSUI and Shimpu OSHIMA, [S. S. H., **6** (1935), 173–180.] — In the previous work the authors noted that inanition applied intermittently for some certain days promotes the growth of the carp, that is, more increase of body weight of the carp was observed than in the case of continued feeding in the same length of experimental periods. In the present study the experiment is repeated and the result is retested. However, contrary to expectation similar result is not obtained. No promotion of the growth by inanition intermittently applied is observed or even the retardation of the growth is resulted compared to the continued feeding. I. Amemiya.

626. Studies on the Food for Fish-culture with the Carp. (Japanese with English abstract.) Yoshiichi MATSUI and Simpu OSHIMA. [S. S. H., **6** (1935), 181–220.] — Many kinds of materials were experimentally used for feeding of the carp and studied on their effect on the growth of the fish. The carp feeds most preferably on fish-meal; dried *Gammarus* and *Tecticeps*, and wheat flour, bean-cake and salted mysis come next in the order given, while silk-worm pupae in the last. However, in the growth of the carp silk-worm pupae are most effective, then cod-roe, fish and crab-meat, and fish-meal in the last. Wheat flour and bean-cake have little or no value for the growth of the carp. I. Amemiya.

627. On the Property of the Fat in Cultured Eel and Carp. (Japanese with English abstract.) Shimpu OSHIMA. [S. S. H., **6** (1935), 221–229.] — Irrespective of the cultured fish species, the bromine quantity of bromide of their fat is over 68.20% when the fish are fed with sardine and less than 63.9% when fed with silk-worm pupae. The bromine quantity in the eel grown in the wild is 66.14–67.12%, that of the carp similarly grown 65.52%.
I. Amemiya.

628. Effect of Feeding with Red Pepper and Soy-bean Oil Irradiated by Ultra-violet Rays upon the Growth, Egg-production etc. in Trouts. (Japanese with English abstract.) Kuzo HATA. [S. S. H., **6** (1935), 229–237.] — Rainbow trout and brook trout fed with food to which red pepper and soy-bean oil irradiated by ultra-violet rays were added show increased rate of growth and more production of eggs. Fries hatched from eggs of fish thus fed are healthier than those from eggs of fish of ordinary feeding. I. Amemiya.

629. On the Death and Oxygen Consumption of Sardine in Confinement. (Japanese with English abstract.) Kinosuke KIMURA. [S. S. H., 6 (1935), 239–280.] I. Amemiya.

630. Investigation in the State of Important Fisheries. II. On the Skipper *Cololabis saira* Brev. Fishery. (Japanese with English abstract.) Itaro TAKAYAMA and others. [S. S. H., 6 (1935), 281–310.] I. Amemiya.

631. On the Constitution of Skipper, *Cololabis saira* Brev., Fished by Drift-nets in the North-eastern Waters of Japan. (Japanese with English summary.) Michio UNO. [N. S. Gk. S., **4,** No. 3 (1935), 158–160.] — Body lengths l_1, l_2 and l_3 at the time when respectively the first, second and third year-ring on the scale were formed were statistically measured separately according to localities. No local difference was observed in those body lengths. In the fourth year group there are two categories, the one having a spawning mark and the other not. The former category occupies 77–88% of fish caught in the waters north of Tiba Prefec-

ture and 65% in the southern waters off Mie Prefecture. The body length belonging to the former category is longer than the latter. I. Amemiya.

632. **The Distribution and the Habits of Hump-back Whales in the Adjacent Waters of Japan.** (Japanese with English summary.) Yoshio MATSUURA. [N. S. Gk. S., **4,** No. 3 (1935), 159–170.] — The hump-back whales, *Megaptera nodosa* (Bonnaterre), are caught almost exclusively in the southern waters of Japan, around the Bonin Islands and near the southern part of Formosa in winter when the surface temperature is 20–27°C, although in the summer the whales are found in waters as far north as Kamtchatka and Bering Sea according to Russian reports. The main herd of the whale presumably migrate annually between the said regions taking their route far off in the Pacific beyond the reach of Japanese whalers. And some small herd seems to migrate from the north to the south as far as Yellow Sea through Japan Sea. Females caught in 5 years (1930–1934) amounted 174 in number, which show 47% of the total. They measure 12.4 m in the average of body length. Males caught in the same period were 205 in number and measure 12.0 m in the average. Females attain sexual maturity at the average length of about 14 m. Pairing seems to take place in the early spring in the warm water and the period of gestation takes 10-12 months. I. Amemiya.

633. **The Determination of the Amount of Connective Tissue in Fish.** (Japanese with English summary.) Takeo OYA and Takeo KURAGAKE. [N. S. Gk. S., **4,** No. 3 (1935), 195–197.] — The authors using the filet of several fishes, such as a shark, two flat-fishes, a tunny, the carp and the horse-mackerel as material, measured the amount of connective tissue contained in their meat. At first the fish is well mashed and then sifted through a sieve with small meshes. The residue on the sieve is well soaked with water and extracted for 3-4 hours, then again sifted through a sieve. The residue is dried and weighed as the amount of connective tissue. The amount thus obtained varies from 5.10% of flesh in the hores-mackerel to 11.74% in a shark. Total-N in the connective tissue of dry sample varies from 14% in the carp to 15.2% in a tunny. Collagen-N in total-N of the connective tissue varies from 7.13% in a shark to 10.37% in a tunny. Elastin-N in the same meaning varies from 4.03% in a tunny to 5.64% in a shark. The authors also determined the amount of the change of collagen into gelatine at various grade of temperature and pH. I. Amemiya.

634. **Studies on the Scorpaenoid Fishes of Japan. II. Statistical Examinations on *Sebastodes inermis* (C. et V.).** (Japanese with English summary.) Kiyomatsu MATSUBARA. [N. S Gk. S., **4,** No. 4 (1935), 217–223.] - A group of Scorpaenoid fishes has been regarded by some taxonomists to belong to four different species, as *Sebastodes inermis*, *S. ventricosus* T. et S., *S. güntheri* J. et St. and *S. tokionis* J. et St., while other ichthyologists maintain the view that in the group there are only two different species *S. inermis* and *S. tokionis*. And, furthermore, Tanaka amalgamated all the species into single one, *S. inermis*. The author examined biometrical measurements of very many individuals of the group of the fish and came to the conclusion that the whole material belong to a category which should represent a single species *S. inermis*.
I. Amemiya.

635. ***Coryphaena equisetis* Caught in the Southern Japan Sea.** (Japanese with English summary.) Keitaro UCHIDA. [N. S. Gk. S., **4,** No. 4 (1935), 224–228, 1 text-fig.] — The "small dolphin", *Coryphaena equisetis* L., having not hitherto been reported from Japanese waters is in fact annually fished in August mixed with the common dolphin, *Coryphaena hippurus*, in the south-western Japan Sea, where it is not rare and fishermen know its occurrence.
I. Amemiya.

636. **On the Food of the Salmonoid Fish, "Ayu". *Plecoglossus altivelis* T. et S. III.** (Japanese with English summary.) Saburo UEDA and Yoshikazu OKADA. [N. S. Gk. S., **4,** No. 4 (1935), 233–238, 2 text-figs]. and 1 pl.] — The food of the fish from Korea and Formosa consists chiefly of diatoms, green algae, blue-green algae and some desmids. I. Amemiya.

637. **A New Bramid Fish Found in Japan.** Kiyomatsu MATSUBARA. (English.)

[N. S. Gk. S., **4**, No. 4 (1935), 297-300, 1 text-fig.] — Description of a new bramid fish, *Taractes platycephalus*, which was obtained in Sagami Bay. I. Amemiya.

638. The Identification of the Species of *Oncorhynchus* in the East Coast of Camtchatka. (Japanese with English summary.) Masao OZAKI. [N. S. Gk. S., **4**, No. 5 (1936), 321-324.] — Salmons fished in the east coast of Camtchatka are represented by five species, *Oncorhynchus nerka*, *O. keta*, *O. kisutch*, *O. gorbuscha* and *O. tschawytscha*. The author made minute measurements of body parts in many individuals of each species and compared the result with Jordan's, which shows slight or occasional difference from the author's. I. Amemiya.

639. On the Lesser Rorqual Found in the Adjacent Waters of Japan. (Japanese with English summary.) Yoshio MATSUURA. [N. S. Gk. S., **4**, No. 5 (1936), 325-330.] — The lesser rorqual, *Balaenoptera acuto-rostrata* Lacépède is caught in summer near the Kurile Islands and in winter in the Yellow Sea, Tusima Strait and near the east coast of Corea. Its breeding seems to take place in the south-western habitat, its copulation chiefly from December to March. Its gestation covers a period of 10-12 months. Body length measures 6.1-9.1 m. A female of 7 m long was found pregnant. There are two main routes in the southward migration, one in the Japan Sea and the other in the Pacific. I. Amemiya.

640. Flat Fishes in the Northern Waters of Japan. (Japanese.) Toyodi HIKITA. [S. K. I., **4** (1934), 187-297, 29 pls. 1 coloured.] — Revision and description of fishes belonging to Heterosomata found in the northern waters of Japan. The author dealt with 19 species of Pleuronectinae, 10 species of Hippoglossinae and 1 species of Soleidae. Among them one species, i. e., *Pseudoplatichthys oshoroensis* n. g., n. sp., in Pleuronectinae was new to science. In the present study the examination of fishes was caried out not only by their external morphology but also by osteology. The work is well illustrated by numerous figures. I. Amemiya.

641. On the Development of the Japanese Abalone. Saburo MURAYAMA. [Journ. Coll. Agric., Tokyo Imp. Univ., **8**, No. 3 (1935), 227-233, 2 pls.] — The spawning of the gastropod was induced by adding the sperm into the respirating water in the coop where ripe females were kept. The egg measuring 0.27 mm in dia. is coloured deep bluish green in the animal pole and pale yellow in the vegetative. At the animal pole are given off one or two polar bodies. The first and second cleavage are meridional, total and equal, while the third and fourth are latitudinal, total and unequal. The morula stage is attained in 8 hours after fertilization at about 17°C, gastrula in 13 hours and trochophore in 14 hours or more. The larva hatches out at trochophore stage and swims freely in the water in 21-22 hours after fertilization. In trochophore the anlage of the larval shell appears and eventually the trochophore transforms itself into the veliger, in which stage the ano-pedal flexure occurs. The larval shell is completed in about 41-42 hours and measures 0.36 mm in length. The shell-protected larva is furnished with the velum, opercle, heart, eyes, mouth, anus etc. As long as the velum is functional the veliger is able to swim, but soon afterward its foot develops and the larva settles on the substratum. After the opercle is discarded the larva begins to form the post-larval shell or the peristomal shell around the margin of the primary larval shell. The peristomal shell grows much larger on the right side than on the left and the larva rests on the bottom with its left side down. In the peristomal shell stage a mantle cleft appears at the median line of the body and accordingly the incision of the peristomal shell appears at that place. In the next stage when the peristomal shell grows to measure 2.3 mm long the adult shell begins to grow around the margin of the peristomal shell. The adult shell has similarly the incision from its beginning corresponding to the cleft of the mantle and grows increasingly much larger on its right side than on its left side; as the result, the adult shell shows its characteristic form of *Haliotis*. The shell perforations are formed on the line where the left and right mantle lobes meet. The whole developmental process is well described and illustrated by 30 figures. I. Amemiya.

642. Genetical Studies on Gold-fish of Japan. Yoshiichi MATSUI. [Journ. Imp. Fish. Inst., **30**, No. 1 (1934), 1-96, 12 pls. 3 coloured.] — The work consists of four parts; 1) On the varieties of gold-fish and the variations in their external characteristics. 2) On the Mendelian

inheritance of the telescope eyes of gold-fish. 3) On the inheritance of the scale transparency of gold-fish. 4) On the inheritance of caudal and anal fins of gold-fish. As existing races there are 13 races of gold-fish in Japan and in addition 6 kinds of hybrid. As extinct race the author mentions 1 which was called Hanafusa. He explains in the first part the genetical relationship of these races and hybrids confirmed by experimental rasults. The character of telescope-eye is recessive against that of the normal eye, and these characters are inherited as a Mendelian monohybrid. Transparent scale and the normal scale are inherited as monohybrid, and the net-like transparent scale and the normal scale are also monohybrid, while the net-like transparent scale and the mosaic transparent scale are dihybrid. The Hiraki-wo or the opened-caudal of gold-fish are on the whole homozygous, but sometimes they segregate a small number of normal caudal. The normal caudal of gold-fish and that of *Carassius* have quite a different hereditary relation to the opened-caudal of gold-fish. The normal caudal of *carassius* is dominant over the opened-caudal. Various anal fins of gold-fishes show complex segregation and complex manner with respect to their inheritance. I. Amemiya.

643. Effect of Gill Excision upon the Sexual Differentiation of the Oyster, *Ostrea gigas* Thunberg. (Japanese.) Ikusaku AMEMIYA. [Nippon Gakuzyutu Kyôkwai Hôkoku, **10,** No. 4 (1935), 1023–1026.] — About one third of each of all gill lamellae was excised at the time when the gonad of the oyster became neutral, that is, in late autumn. The wound was well severed by the creature. Most of oysters thus operated survived and only a very small portion of individuals died. Same numbers of normal (control) and operated oysters all mixed and put in cages were relaid in the sea where they were left for about seven months. Their sexes were examined in the next summer when they were sexually differentiated, the gonads being ripen. The result was as follows:

Batch I

Operated					Control				
♂	♀	☿	?	total	♂	♀	☿	?	total
43	106	1	0	150	39	112	2	0	153

♂ : ♀ = 100 : 246.51 ♂ : ♀ = 100 : 287.18

Batch II

Operated						Control					
♂	♀	☿	?	dead	total	♂	♀	☿	?	dead	total
96	123	5	0	17	241	87	144	3	1	5	240

♂ : ♀ = 100 : 128.13 ♂ : ♀ = 100 : 165.52

Batch III

Operated						Control					
♂	♀	☿	?	dead	total	♂	♀	☿	?	dead	total
78	61	9	3	76	227	102	111	11	0	8	232

♂ : ♀ = 100 : 78.20 ♂ : ♀ = 100 : 108.82

Thus, it is quite clear that in the operated group in all cases the number of male differentiation is larger than that in the normal, or, in the normal group in all cases the number of female differentiation is larger than that in the operated. The superiority of female differentiation in sex-ratio in control compared to operated is tabulated as follows:

Batch I. 287.18 − 246.51 = 40.67
Batch II. 165.52 − 128.13 = 37.39
Batch III. 108.82 − 78.20 = 30.62

The author discussed upon the said experimental results. As the gills are organ of feeding and

respiration at the same time in the oyster, the partial excision of gill-lamellae causes incomplete feeding in addition to physiological injury to the individual by the wound. The ill condition, so to speak, with regard to nutrition and physiology induces the oyster to differentiate more strongly towards the male sex than towards the female. I. Amemiva.

644. Preliminary Note on the Pearl Organs in Some Japanese Cyprinoid Fishes. Yaichirô OKADA. [Sci. Rep. Tokyo Bunr. Daig., Sec. B., 2, No. 28 (1934), 29-36, 3 pls., 2 tabs.] — The pearl organs and their characteristic distribution on the surface of the body are compared among the following genera of Japanese cyprinoid fishes: *Cyprinus* (*C. carpio*), *Carassius* (*C. auratus*), *Tribolodon* (*T. hakonensis*), *Acheilognathus* (*A. limbatus, A. cyanostigma, A. lanceolatus, A. tabira, A. rhombeus, A. longipinnis* and *A. moriokae*,) *Ischikauis* (*I. steenackeri*), *Zacco* (*Z. platypus, Z. temmincki*), *Opsariichthys* (*O. uncirostris*), *Sarcocheilichthys* (*S. variegatus*) and *Pseudorasbora* (*P. parva*). The organs appear in a relatively late stage in the large forms such as *Opsariichthys, Ischikauia, Tribolodon* and *Cyprinus*, whereas they appear at an earlier stage of development in the case of the smaller species of *Acheilognathus*. A. Ichikawa.

645. On the Later Pelagic Larvae and Early Benthic Youngs of *Anadara inflata* (Reeve). (Japanese with English summary.) Hiroshi YOSHIDA. [Venus, 5, No. 1 (1935), 1-10, 2 figs., 1 pl.] — In the developing gray-coloured larval shell, the prodissoconch is distinct on the umbonal portion of the shell. The size of the prodissoconch is 0.25×0.19 mm - - 0.28×0.21 mm, its colour is yellow with many concentric lines on its surface. During August to October, at the season of spawning, veliger larvae with prodissoconchs are found in the plankton of Tinkai Bay, South Korea, the fishing grounds of this bivalve. The blunter umbo and greater number of concentric lines of the embryonic shell, are the chief characteristics by which this veliger is distinguished from that of the allied and concurrent species, *A. subcrenata*. The smallest veliger the author figured was 0.15×0.12 mm. He reared fully grown veligers, 0.24 mm to 0.28 mm in length, and obtained the young of the benthonic life. A. Ichikawa.

646. On the Variation of Certain Internal Features of the Fossil *Terebratalia coreanica* from Hokkaidô. Sitihei NOMURA and Kotora HATAI. [Venus, 5, No. 1 (1935), 10-13, 5 figs.] — *Terebratalia coreanica* (Adams and Reeve) is a common brachiopod in the seas surrounding northern part of Japan and is also found as fossil from Miocene to Recent, or it may date back to pre-Miocene. The shell beds of the Setana Group of Profs. Nagao and Sasa developed in the southwestern part of Hokkaido abound with the fossil specimens which attained a large size rarely to be met with in the recent specimens, and show a wide range of variation in their external as well as internal features of the isolated valves. A. Ichikawa.

647. On the Fossil Specimen of *Macoma calcarea* (Gmelin) from Kazusa. (Japanese.) Tsuneteru OIMIKADO and N. IKEBE. [Venus, 5, No. 1 (1935), 14-17, 6 figs.] — The pallial sinus of fossil *Macoma calcarea* collected from the upper part of the Tôgane silt bed of the uppermost Pliocene age, is compared with that of *M. masuta* and *M. tokyoensis*.
A. Ichikawa.

648. The Distribution of *Viviparus* (*Cipangopaludina*) *chinensis malleatus* (Reeve) in Chôsen. Noboru SHIBA. [Venus, 5, No. 1 (1935) 17-22, 7 figs., 1 map.] — Description of this species, the sole representative of the Genus *Viviparus* in Chosen, with its geographical distribution and variation. A. Ichikawa.

649. On the Convexity of the Shell of *Anodonta*. (Japanese.) Kazumasa HAYASHI. [Venus, 5, No. 1 (1935) 23-25, 3 figs., 1 tab.] A. Ichikawa.

650. A List of Fresh Water Shells of Taiwan. (Japanese.) Yasuichi HORIKAWA, [Venus, 5, No. 1 (1935), 26-33, 12 figs., 1 pl.] — The list comprises Corbiculidae (8 species), Mytilidae (1 species), Planorbidae (3 species), Ancylidae (1 species), Lymnaeidae (2 species), Thiaridae (8 species), Viviparidae (2 species), Bulimidae (6 species) and Neritidae (4 species).
A. Ichikawa.

651. Shell Fauna of Lake Saruma, Hokkaido. (Japanese.) Toraichirô KINOSHITA. [Venus, 5, No. 1 (1935, 34–38, 2 figs.] A. Ichikawa.

652. Vernacular Names of Shells at Kominato, Tiba Prefecture. (Japanese.) T. INO. [Venus, 5, No. 1 (1935), 38 41.] A. Ichikawa.

653. Descriptions of Three New Subspecies of *Valvata* from Nippon. Denzaburo MIYADI. [Venus, 5, No. 2. 3 (1935, 59–62, 1 pl.] — *Valvata piscinalis japonica* emended (= *V. japonica Martens*), *V. piscinalis simusyuensis*, *V. pulchella saghalinensis* and *V. cristata hokkaidoensis* are described. A. Ichikawa.

654. Two New Species of *Oncidiella* from Japan (Pulmonata.) Iwao TAKI. [Venus. 5, No. 2. 3 (1935). 63–69, 1 pl., 3 figs.] — Descriptions of *Oncidiella kurodai* and *O. orientalis*. A. Ichikawa.

655. Review of the Ringiculidae of Japan (Fossil and Recent). Toshio TAKEYAMA. [Venus, 5, No. 2. 3 (1935), 69–90, 2 pls.] - A revision is made of old and new species and subspecies of the Japanese Ringiculidae. The account of each form includes description, taxonomic remarks and geographical and stratigraphical records. *Ringicula (Ringicula) makiyamai*, *R. (Ringiculella) yokoyamai*, *R. (Ringiculella) pacifica kurodai*, *R. (Ringiculella) shimaensis*, *R. (Ringiculella) nakamurai*, *R. (Ringiculella) ninohensis kuensis*, *R. (Ringiculella) minoensis* and *R. (Ringiculella) fragilis* are new. A. Ichikawa.

656. Über eine Atypische Begattung zwischen den verschiedenartigen Schnecken *Chloritis bracteatus* Pilsbry und *Ch. fragilis* Gude. Morphologische und physiologische Betrachtungen über das Genitalsystem der japanischen Pulmonaten. III. (Japanese with German summary.) Shigeo EMURA. [Venus, 5, No. 2. 3 (1935), 90 99, 5 figs.] — A smaller individual (*Chloritis fragilis*) was found dead when it was reared with a larger specimen of another species, *ch. bracteatus*. After autopsy, the author concluded the cause to be abnormal copulation which broke the vagina of *ch. fragilis*. A. Ichikawa.

657. A General Sketch of the Molluscs inhabiting the Coral Reef of the Okinawa Islands, (Japanese.) Kikutaro BABA. [Venus, 5, No. 2. 3 (1935), 99–102, 3 pls.] A. Ichikawa.

658. Notes on Regeneration of the Shell of Helicid Snails. (Japanese.) Kazumasa HAYASHI. [Venus, 5, No. 2. 3 (1935), 102-104, 1 fig.] - Shell-repairs after removal of various parts of the shell by the snail *Euhadra callizona amaliae* was studied. When a piece was removed from the aperture edge, at first the periostracum was secreted beneath which the normal organization of the shell may be completed after about 2 weeks. When pieces were removed from the first whorl, from the 2nd whorl or from the apex, the regenerating new parts have no cuticle. A. Ichikawa.

659. Some Ecological Observations on the Fresh-water Snails, *Melanoides (Semisulcospira) libertinus*, *M. (S.) libertinus japonicus* and *M. (S.) niponicus*. (Japanese.) Shuichi MORI. [Venus, 5, No. 2. 3 (1935, 105–112, 4 figs, 2 tabs.] — The feeding and breeding habits of these species are given. Supported by experimental evidence, the conclusion is also drawn, that the snail *M. (S.) niponicus* chooses the water where a considerable wave action may exist and as for the substratum the animal prefers the rough rocks. A. Ichikawa.

660. A History of Japanese Conchology. 16. (Japanese.) Tajima KANAMARU. [Venus, 5, No. 2. 3 (1935), 112–117, 2 figs.] A. Ichikawa.

661. Talks on Shells of Tôhoku District. 6. (Japanese.) Genzo TOBA. [Venus, 5, No. 2. 3 (1935), 117–120.] A. Ichikawa.

662. On the Distribution and Variation of *Anodonta arcaeformis* in the Environs of Sapporo. (Japanese.) Kazumasa HAYASHI. [Venus, 5, No. 2. 3 (1935), 120–123, 1 tab., 2 figs.] A. Ichikawa.

663. A List of the Genera of Japanese Molluscs. 6. (Japanese.) Tokubei KURODA. [Venus, 5, No. 2. 3 (1935), 123-141.] A. Ichikawa.

664. A List of the Genera of Japanese Cephalopods. (Japanese.) Iwao TAKI. [Venus, 5, No. 2. 3 (1935), 141-145.] A. Ichikawa.

665. Notes on Some Cases of Artificial Propagation of Molluscs. (Japanese.) Tajima KANAMARU. [Venus, 5, No. 2. 3 (1935), 145-149, 1 figs.] — The author presumed that the mussel *Mytilus edulis* found on the littoral zone in Kôbe Harbour had been introduced by ships. A. Ichikawa.

666. A List of Japanese Species of *Buccinum*. (Japanese.) Tokubei KURODA. [Venus, 5, No. 2. 3 (1935), 149–161.] A. Ichikawa.

667. A Narrative of the Collecting Trip to the South Sea Islands. (Japanese.) Takebumi ONOYAMA. [Venus, 5, No. 2. 3 (1935), 161-174, 1 map, 7 photos.] - Biological and faunistic notes on molluscs. A. Ichikawa

668. On Three Molluscan Species from Taiwan. (Japanese.) I. HAYASAKA and K. TAN. [Trans. Nat. Hist. Soc. Formosa, 24, No. 133 (1934), 259-262, 1 figs.] - Notes on three rare bivalves from Formosa: *Pinctada chemnitzi* (Philippi), *Unio douglasiae taiwanicus* (Pilsbry) and *Cristaria discoidea sauteri* Haas. I. Harada.

669. On a Rare Shark from Formosan Waters. (Japanese.) H. NAKAMURA. [Trans. Nat. Hist. Soc. Formosa, 24, No. 135 (1934), 186-188, 1 pl.] — Description of *Galeocerdo tigrinus* Müller & Henle from Formosan waters. I. Harada.

670. Über Zwei Species von *Orphaneus*. (Japanisch.) Y. TAKAKUWA [Trans. Nat. Hist. Soc. Formosa, 24, No. 135 (1934), 491-498, 6 figs.] — Beschrieben werden *Orphaneus brevilabiatus* Newp. aus Formosa und *O. platypedatus* n. sp. aus Marshallinseln. I. Harada.

671. On the Croak of *Hyla chinensis*. (Japanese.) Y. HORIKAWA. [Trans. Nat. Hist. Soc. Formosa, 24, No. 135 (1934), 499-505.] — The author recorded the croak of the tree-frog, *Hyla chinensis*, in relation to the season and the weather and came to the conclusion that it is irrespective of the rain fall, but is confined to the temperature above 22°C. I. Harada.

672. On the Land-Hermits (Coenobitidae) in Formosa. (Japanese.) Sadae TAKAHASHI. [Trans. Nat. Hist. Soc. Formosa, 24, No. 135 (1934), 506-517, 5 figs.] - Five species of landhermits, *Birgus latro* (Linn.), *Coenobita rugosus* Milne-Edwards, *C. perlatus* Milne-Edwards, *C. cavipes* Stimpson. *C. hilgendorfi* Terao from Formosa are described in regard to their habits and distributions. I Harada.

673. Notes on Hydridae of Kôtôsho (Botel Tobago Island). (Japanese.) S. TAKAHASHI. [Trans. Nat. Hist. Soc. Formosa, 25, No. 140 (1935), 142-144, 1 fig.] — Six species of sea-snakes, *Laticauda semifasciata* (Reinwardt), *L. colubrina* (Schneider), *Emydocephalus ijimae* Stejneger, *Disteira spiralis melanocephala* (Gray), *Pelamydrus platurus* (Linnaeus), are recorded from Kôtôsho, with notes on their habits and utilization. I. Harada.

674. Über Intersexualität bei *Katsuwonus pelamis* (Linn.). (Japanese.) Hiroshi NAKAMURA. [Trans. Nat. Hist. Soc. Formosa, 25, No. 141 (1935), 197-198, 1 fig.] — Eine Exemplar von Intersexualität bei *Katsuwonus pelamis* wird beschrieben. I. Harada.

675. Cladocera from Shanghai (China). (Japanese.) Masuzo UÉNO. [Trans. Nat. Hist. Soc. Formosa, 25, No. 142 (1935), 212-215, 3 figs.] — Six species of Daphniidae, *Daphnia psittacea* Baird, *D. pulex* (de Geer) subsp. *obtusa* Kurz, *Simosa vetuloides* (G. O. Sars), *Scapholeberis kingi* G. O. Sars, *Ceriodaphnia laticaudata* P. E. Müller and *Moina geei* v. Brehm; and three species of Chydoridae, *Alona guttata* G. O. Sars, *Pleuroxus trigonellus* O. F. Müller and *Chydorus gibbus* Lilljeborg are described and recorded from Shanghai. I. Harada.

676. A New Poisonous Snake (*Calliophis iwasakii*) from Loo-Choo. M. MAKI. [Trans. Nat. Hist. Soc. Formosa, **25**, No. 142 (1935), 216-219, 3 figs.] — *Calliophis iwasakii* Maki, a new poisonous snake, is described and recorded from the island of Ishigaki (Loo-Choo). I. Harada.

677. On the Two Species of the Tresher Shark from Formosan Waters. H. NAKAMURA. (Japanese.) [Mem. Fac. Sci. Agr., Taihoku Imp. Univ., **14**, No. 1 (1935), 1-6, 2 pls. and Trans. Nat. Hist. Soc. Formosa, **25**, No. 142 (1935), 220-225.] — The author described and proposed two new species of Alopiidae, *Alopius pelagicus* n. sp. and *A. profundus* n. sp., in the Pacific, both of which have been identified with the Atlantic species of *A. vulpes*. The embryos of both species are also described. I. Harada.

678. Ecological Study of Formosan Freshwater Molluscs. (Japanese.) Y. HORIKAWA. [Trans. Nat. Hist. Soc. Formosa, **25**, No. 142 (1935), 226-231.] — Brief notes on the habits of 36 species of formosan freshwater molluscs. I. Harada.

679. Inland Water Fauna of Formosa. I. Crustacea, Decapoda. (Japanese.) M. UÉNO. [Trans. Nat. Hist. Soc. Formosa, **25**, No. 143 (1935), 270-276, 4 figs.] — *Leander modestus* Heller (Palaemonidae), and *Caridina nilotica gracilipes* de Man and *C. denticulata sinensis* Kemp (Atyidae) are described and recorded from Formosa. I. Harada.

680. Inland Water Fauna of Formosa. II. Cladocera (1). (Japanese.) M. UÉNO. [Trans. Nat. Hist. Soc. Formosa, **25**, No. 144 (1935), 293-299, 6 figs.] — *Diaphanosoma brachyurum* (Liévin), *D. paucispinosum* v. Brehm, *Ceriodaphnia rigaudi* Richard, *Bosmina longirostris* (Müller), *Macrothrix laticornis* (Jurine) and *Alnoa rectangula* G. O. Sars are recorded and described. I. Harada.

681. Inland Water Fauna of Formosa. III. Rotatoria. (Japanese.) M. UÉNO. [Trans. Nat. Hist. Soc. Formosa, **25**, No. 144 (1935), 300-307, 4 figs.] — *Asplanchna priodonta* Goosse, *Filinia longiseta* (Ehrenberg), *Rattulus capucinus* Wierzejski et Zacharias, *Schizocerca diversicornis* Daday, *Brachionus pala* Ehrenberg, *B. forficula laevis* Apstein, *Keratella cochlearis* (Goosse) and *K. valga* (Ehrenberg) [f. *tropica-asymmetrica* and f. *tropica-monstrosa*] are described. I. Harada.

682. Über Neue Chilopoden aus Japan. Y. TAKAKUWA. [Trans. Nat. Hist. Soc. Formosa, **25**, No. 145 (1935), 339-343, 3 figs.] — *Mecistocephalus capillatus* n. sp. aus Jaluit (Marshallinseln), *Rhüsida yanagiharai* n. sp. und *R. longipes brevicornis* n. subsp. aus Formosa werden beschrieben. I. Harada.

683. Biometrical Studies on *Rattus losea* (Swinhoe). I. (Japanese with English résumé.) B. AOKI and R. TANAKA. [Journ. Soc. Trop. Agr., Taihoku Imp. Univ., **6**, No. 3, (1934), 475-494, 13 figs.] — The variations of cranial and external characteristics due to age, sex and individual difference are studied statistically in *Rattus losea*. The tail length shows 3-4 growth stages with differential growth rates, and its relative maximum length is attained at the length of the head and body of 90-130 mm in both sexes, while the length of hind foot and ear and the number of annuli of the unit length of tail respectively two differential growth stages, breaks of which take place a trifle earlier than the period of relative maximum tail length. Judging from the percentage increase in the cranial measurments, the pre-orbital region is most unstable, the inter-orbital most stable, on the other hand, from the view point of differential

growth rate, the pre-orbital approaches its final proportion latest, the post-orbital earliest. The relatively uniform adult type of colouration of the pell and the tail etc. is attained at the length of the head and body of about 130 mm. The present species lies statistically between the roof rat and the Norway rat, in so far as the relation between the means of the length of the head and body and the tail in the adult is concerned. I. Harada.

684. **Einige Ichneumoniden-Arten aus China.** Toichi UCHIDA. [Ins. Mats., 9, No. 1, 2 (1934), 1-5.] — Notizen über 14 Arten. Von diesen Arten ist eine Art, *Ephialtes chui*, für die wissenschaftliche Welt neu, und 9 Arten sind vielleicht neu für China. S. Kuwayama.

685. **Die Sipalinen Japans (Col. Curc.)** Hiromichi KÔNO. [Ins. Mats., 9, No. 1, 2 (1934), 6-8.] — Beschreibungen von *Sipalus hypocrita* Boheman und *S. formosanus* n. sp. S. Kuwayama.

686. **On Two Braconid Parasites of Sugar Cane Pests in Formosa.** Chihisa WATANABE. [Ins. Mats., 9, No. 1, 2 (1934), 8-11.] — Descriptions of the adults and cocoons of *Shirakia jokohamensis* (Cameron) and *Macrocentrus jacobsoni* Szépligeti, which are parasitic on the larva of *Scirpophaga nivella*. S. Kuwayama.

687. **Beitrag zur Kenntnis der Fungivoriden-Fauna Japans. I. Bolitophilinae (Dipt.).** Ichiji OKADA. [Ins. Mats., 9, No. 1, 2 (1934), 12-18, 1 fig.] — Beschreibungen und Bestimmungstabellen der in Japan vorkommenden Gattungen und Arten. Neue Art: *Bolitophilella japonica*. S. Kuwayama.

688. **Notes on Braconidae of Japan. V. Euurobracon.** Chihisa WATANABE. [Ins. Mats., 9, No. 1, 2 (1934), 19-23, 1 fig.] — Descriptions of *Euurobracon yokohamae* (Dalla Torre) and *E. breviterebrae* n. sp. S. Kuwayama.

689. ***Acerataspis* nom. nov. (Hym. Ichneum. Metopiinae).** Toichi UCHIDA. [Ins. Mats., 9, No. 1, 2 (1934), 23.] — Neue Name für *Cerataspis* Uchida (nec Gray). S. Kuwayama.

690. **Über die Gattungen *Hesperinus* und *Pachyneura* (Neue und wenig bekannte Dipteren aus Japan. I.).** Ichiji OKADA. [Ins. Mats., 9, No. 1, 2 (1934), 24-26, 2 figs.] — Beschreibungen von *Hesperinus nigratus* n. sp. und *Pachyneura fasciata* Zetterstedt. S. Kuwayama.

691. **Die Heteromeren von Sachalin.** Hiromichi KÔNO. [Ins. Mats., 9, No. 1, 2 (1934), 27-40.] — Übersicht der 46 Arten unter 11 Familien, mit Beschreibungen von neuen Oedemerid-Gattung *Ezonacerda* (Typus: *Oedemera nigripennis* Matsumura und neue Alleculid-Art, *Pseudocistela watanabei*. S. Kuwayama.

692. **Beiträge zur Systematik der Tribus Acoenitini Japans (Hym. Ichneum. Pimplinae).** Toichi UCHIDA. [Ins Mats., 9, No. 1, 2 (1934), 41-54, 3 figs.] — Beschrieben sind 17 Arten und 5 Formen unter 7 Gattungen, darunter die folgenden 3 Arten und 2 Formen neu. Neue Arten: *Arotes sugiharai*, *A. odontus*, und *Siphimedia rishiriensis*. Neue Formen: *Siphimedia apicalis* f. *tosaensis* und *S. apicalis* f. *yakushimaensis*. S. Kuwayama.

693. **Fauna of the Thysanoptera in Japan. Part V.** Masato ISHIDA. [Ins. Mats., 9, No. 1, 2 (1934), 55-59, 2 figs.] — Descriptions of 2 new species, *Thrips moultoni* and *T. mucunae*. S. Kuwayama.

694. **Insects Collected at the Foot of Mt. Yatsugadake and its Environment.** Shonen MATSUMURA. [Ins. Mats., 9, No. 1, 2 (1934), 60-80.] — A list of 180 species under 49 families of 11 orders. New species: (Coleoptera) *Luperodes suzukii*, *Aphodius* (*Acrossus*) *koichianus*, *Oniticellus yohenai*, *Onthophagus koichii*, *O. minokuchianus*, *O. shinanensis*, (Rhynchota) *Tricentrus yatsugadakensis*, *Aphrophora binomoriensis*, *A. musashiana*, *A. takaii*, *A. yatsugadakensis*,

A. yohenai, *Awafukia* (n. g.) *hirayamai*, *Peuceptyelus inokashiranus*, *P. oiwakensis*, *P. takaosanus*, and *Ptyleus takaii*. New form: (Coleoptera) *Monochammus sartor* f. *takaii*. S. Kuwayama.

695. Einige Ichneumoniden-Arten aus China. (II). Toichi UCHIDA. [Ins. Mats., 9, No. 3 (1935), 81-84, 1 fig.] — Notizen über 5 Arten. *Phaeogenes eguchii* und *Phygadeuon latipetiolator* sind neu. S. Kuwayama.

696. Die Heteromeren aus den Kurilen (Col.) (Erster Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., 9, No. 3 (1935), 85-89.] — Beschreibungen von 16 Arten unter 6 Familien. Neue Unterarten: *Pseudopyrochroa rufula etorofuensis* und *Stenophanes strigipennis doii*. S. Kuwayama.

697. On Two Hymenopterous Guests of Ants in Japan. Chihisa WATANABE. [Ins. Mats., 9, No. 3 (1935), 90-94, 2 figs.] — Descriptions of the adults and the notes on the biology of *Paxylomma arakawae* (Matsumura), probably parasitic on *Lasius fuliginosus*, and *Elasmosoma berolinense* Ruthe, parasitic on *Formica rufa japonica*. S. Kuwayama.

698. Die Malacodermen aus den Kurilen (Col.) (Zweiter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., 9, No. 3 (1935), 95-98.] — Beschreibungen von 12 Arten unter 4 Familien. S. Kuwayama.

699. Die Rüsselkäfer aus den Kurilen (Dritter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., 9, No. 3 (1935), 99-107.] — Beschreibungen von 22 Arten. Neue Arten: *Coeliodes etorofuensis* und *Apion* (*Pseudopirapion*) *uruppense*. S. Kuwayama.

700. Beiträge zur Kenntnis der Ichneumoniden-Fauna der Kurilen. Toichi UCHIDA. [Ins. Mats., 9, No. 3 (1935), 108-122, 1 fig.] — Beschreibungen von 17 Arten. Neue Arten: *Ichneumon iriribushiensis*, *Bassus urupensis* und *Otlophorus crassitarsus*. S. Kuwayama.

701. On New Species of Epicopeia (Lep.). Shonen MATSUMURA. [Ins. Mats., 9, No. 3 (1935), 123-124, 1 fig.] — Description of *Epicopeia hirayamai*. S. Kuwayama.

702. Revision of *Stenocranus* Fieb. (Hom.) and its Allied Species in Japanese Empire. Shonen MATSUMURA. [Ins. Mats., 9, No. 4 (1935), 125-140.] — Descriptions of 29 new species under 5 genera, of which 3 are new to science. New species and form: *Stenocranus akashiensis*, *S. breviceps*, *S. elongatus*, *S. fallax*, *S. formosanus*, *S. harimensis*, *S. hopponis*, *S. koreanus*, *S. niisimai*, *S. ogasawarensis*, *S. sapporensis*, *S. tamagawanus*, *S. tateyamanus*, *S. vittatus*, *Unkana hakonensis*, *U. arisana*, *U. heitonis*, *U. nigrifacies*, *U. nigrifacies* f. *hyalipennis*, *U. tateyamaella*, *U. malayana*, *Chloriona arakawai*, *C. japonica*, *C. tosaensis*, *C. sachalinensis*, *C. shikokuana*, *C. sukumonis*, *C. tateyamana*, *Noda karafutona*, and *Hikona formosana*. New genera: *Unkana* (Type—*U. hakonensis* Matsumura), *Noda* (Type—*N. karafutona* Matsumura), *Numata* (Type—*Stenocranus sacchari* Matsumura), and *Hikona* (Type—*H. formosana* Matsumura). S. Kuwayama.

703. Einige Ichneumoniden-Arten aus China. (III). Toichi UCHIDA. [Ins. Mats., 9, No. 4 (1935), 140-143, 1 fig.] — Beschreibungen von 6 Arten, darunter eine Art, *Epiurus mencianae*, ist neu. S. Kuwayama.

704. The Obriini of the Japanese Empire (Coleopt., Cerambycidae). J. Linsley GRESSITT. [Ins. Mats., 9, No. 4 (1935), 144-153.] — An enumeration of 11 species under 4 genera, including 3 new species and one genus. New species: *Stenhomalus pallidus*, *S. ruficollis*, and *Iphrobrium dilatipenne*. New genus: *Iphrobium* (Type—*I. dilatipenne* Gressitt). New name: *Pseudiphra* for *Obriomorpha* Matsushita (nec Aurivillius). S. Kuwayama.

705. Einige Bolitophilinen aus Japan (Dipt., Fungivoridae) (Nachtrag). Ichiji OKADA. [Ins. Mats., 9, No. 4 (1935), 154-156, 1 fig.] — Notizen über 5 Arten. *Bolitophila*

tarsata ist neu. S. Kuwayama.

706. Drei neue Heteromeren aus Japan und Formosa, mit einer Liste der geographischen Verbreitung der japanischen Pyrochroiden und Pediliden. Hiromichi KÔNO. [Ins. Mats., **9**, No. 4 (1935), 157-161, 1 fig.] — Beschreibungen von *Tosadendroides* (n. g.) *okamotoi*, *Pseudodendroides uraiana*, und *Ischalia arisana*. S. Kuwayama.

707. Die Lamellicornien aus den Kurilen (Vierter Beitrag zur Kenntnis der Käferfauna der Kurilen). Hiromichi KÔNO. [Ins. Mats., **9**, No. 4 (1935), 162-165.] — Beschreibungen von 13 Arten unter 2 Familien. S. Kuwayama.

708. Über die Gattung *Phryne* Meigen (Phryneidae) (Neue und wenig bekannte Dipteren aus Japan. II.) Ichiji OKADA. [Ins. Mats., **9**, No. 4 (1935), 166-172, 3 figs.] — Beschreibungen und Bestimmungstabellen der in Japan vorkommenden 4 Arten. Neu Art: *Phryne matsumurai*. S. Kuwayama.

709. Descriptions of One New Species and One New Form of Butterflies from Japan and Formosa. Shonen MATSUMURA. [Ins. Mats., **9**, No. 4 (1935), 173-174, 2 figs.] — *Rapala mushana* and *Mycalesis sangaica* Butler f. *ushiodai*. S. Kuwayama.

710. The Oxybelidae of Japan and Korea (Hymenoptera). Keizo YASUMATSU. [Trans. Sapporo Nat. Hist. Soc., **14**, pt. 1 (1935), 38-41, 1 fig.] — Descriptions of 4 species found in Japan proper and Korea, of which one, *Oxybelus strandi*, is new to science.
S. Kuwayama.

711. On Diseases and Insect Pests of Mulberry Trees in Hokkaido. (Japanese.) Teikichi HOTTA. [Journ. Sapporo Soc. Agr. & Forest., **26**, No. 122 (1934), No. 133 (1935), 312-339, 509-510, 3 pls.] — An enumeration of 59 species under 24 families of 6 orders.
S. Kuwayama.

712. The Cabbage Moth (*Barathra brassicae* Linne) in Southern Saghalien. (Japanese with Englich résumé). Matsuji HORI. [Report Saghalien Centr. Exp. Sta., Ser., 1, No. 3 (1935), 1-91, 2 pls.] — In Saghalien, this cabbage moth produces but one generation each year passing the winter in the pupal stage. It is a rather indiscriminate feeder attacking 84 different species of plants under 24 different families, on which plants the author discussed in detail. The length of the larval period varies from 40 to 70 days, depending upon the kind of food. temperature and other conditions. When the insect was fed with suitable food plants such as cabbage. hop, beet, etc., its life period was found to be more prolonged than when fed with others. The author found in the course of his study *Meteorus leviventris*, *Exetastes cinctipes*, *Stenichneumon culpator*, *Euplectrus* sp. and *Ceromasia* sp. as parasites and *Calosoma maderae chinense* and *Carabus granulatus karafutonis* as predators. The injuries to cabbage by several other insects such as *Agrotis ypsilon*, *A. c-nigrum*, *A. fennica* and *Phytometra gamma*, more or less closely resemble that by the cabbage moth. Brief life histories and keys to distinguish the eggs, larvae and pupae of these species are given in the paper. The author also recommended some controlling method devised by his experiments. S. Kuwayama.

713. Chromosomal Variations in the Spermatogenesis of a Grasshopper, *Locusta danica* L. (Orthoptera). (Japanese with English summary). Hidegorô ITOH. [Jap. Journ. Genetics, **10**, No. 2 (1934), 115-134.] — The fundamental complex consists of 23 chromosomes of which 16 are rod-shaped, 6 spheroidal and one the sex-chromosome. 1-4 supernumerary chromosomes apparently produced by fragmentation may be present in some cells of the same individual. When 2 or 4 supernumeraries are present they form 1 or 2 small rod tetrads; when there are 1 or 3 supernumeraries the odd one forms a dyad, having no synaptic mate. In the first spermatocyte the supernumerary tetrad shows no different behavior from ordinary tetrads; but the single dyad stays long on the equatorial plate, and is finally divided equationally and each half joins the daughter chromosome group. In the second division, dyad supernumeraries are divided as usual,

while the monad supernumerary passes to either daughter chromosome group undivided. Consequently numerous classes of spermatozoa are formed, though whether all of them are functional or not is unknown. T. Komai.

714. Cytological Studies on the Silkworm and its Allies. II. Spermatogenesis in *Antheraea yamamai* Guérin, *Antheraea pernyi* Guérin and their Hybrids. (Japanese with German summary). Eisaku KAWAGUCHI. [Jap. Journ. Genetics, **10**, No. 2 (1934), 135-151.] — *Antheraea yamamai* hibernates in the egg stage, while *A pernyi* hibernates in the pupal stage. The maturation divisions of germ cells take place in fall directly after pupation in *A. yamamai*, and in winter in pupa in *A. pernyi*. The reciprocal crosses between the two species produce hybrids which resemble *A. pernyi* in the habit of hibernation, and *A. yamamai* in the period of maturation divisions. The haploid chromosome number is 31 in *A. yamamai*, and 49 in *A. pernyi*. The hybrid has spermatogonial chromosomes varying considerably in number, between 60-63 and 80, 68 69 in average. The spermatogonia contain abundance of mitochondria, which are in forms of spheroidal vacuoles and often arranged radially with the centriole as the center. The Golgi apparatus consists of ca. 20 rings, of which one persists as the acrosome of the spermatozoön. The nucleolus disappears generally before the first maturation division. In the F_1 of *A. pernyi* ♀ × *A. yamamai* ♂, however, the nucleolus remains on the tail of the spermatozoön. This fact supports the view that the nucleolus is probably concerned with the metabolism of the cell. The spermatogonia, spermatocytes and the sperm-heads of the hybrid vary greatly in size, and irregularities including 2-tailed sperms are common. This fact, together with the dificiency in the affinity between chromosomes of different species, is probably the cause of the sterility of the hybrid. T. Komai.

715. Cytological Observation on the Fertilization of the Egg of *Hynobius ratardatus* DUNN. (Japanese with English summary.) Sajirô MAKINO. [Jap. Journ. Genetics, **10**, Nos. 3-4 (1935), 223-232, 1 pl.] — About 1 to 1½ hours after insemination the second polar division is completed, and formation at the second polocyte follows about 1½ to 2 hours after insemination. About 2½ to 3 hours after insemination there is found at the periphery of the egg the already metamorphosed female pronucleus, which moves away from the surface towards the interior of the egg. The spermatozoön enters the egg as early as 15 minutes after insemination, and then, within 1 hour, it metamorphoses into the male pronucleus. The conjugation of the male and female pronuclei generally takes place between the 5th and 6th hour after fertilization. They meet at a distance of about ½ to ⅓ the egg diameter from the animal pole, along an egg-axis joining the second polocyte with the center of the egg. At the time of the conjugation, both pronuclei are quite similar in their structure, size and staining condition; they are nearly spherical with a smooth nuclear membrane and are filled with colourless nuclear sap. Generally they measure 0.038-0.042 mm in diameter. After the two pronuclei meet together, they do not actually fuse, but lie side by side in close contact with the nuclear membrane intact. The maternal and paternal nuclear elements are separated in distinct groups during the stages preparatory to the first cleavage division and the chromosomes are formed independently in each respective nuclear vesicle. In the egg about 7 hours after insemination, the first cleavage spindle is usually found in the process of division. Author.

716. The Chromosomes of *Hynobius dunni* and *H. kimurai*. (Japanese with English summary). Sajirô MAKINO. [Jap. Journ. Genetics, **10**, Nos. 3-4 (1935), 243-244.] — The chromosomes of spermatogonia are observed in *Hynobius dunni* and *H. kimurai*. In both species the number of chromosomes is fifty-six (56), twenty of which are atelomitic V-shaped and remaining thirty-six are telomitic rod-shaped. Author.

717. Spiral Structure of Salivary Chromosomes in *Lycoria* (*Sciara*) and *Drosophila* (a preliminary note). (Japanese with English summary.) Yosindo SINOTÔ & Akira YUASA. [Jap. Journ. Genetics, **10**, Nos. 3-4 (1935), 245-248.] — The salivary chromosomes of *Lycoria* (*Sciara*) and *Drosophila* used in this investigation show a spiral structure which confirms Kaufmann's results (1931) obtained in the case of *Drosophila* and that in the earlier stages of nucleus the primary and secondary spiral chromonemata are seen in the chromosomes or spiremes. The

existence of a tertiary chromonema in the secondary one has been suggested. Authors.

718. The Chromosomes of *Paralithodes camtschatica* and *Gammarus annandalei*. (Japanese.) Hidejirô NIIYAMA. [Jap. Journ. Genetics, 11, No. 1 (1935), 34–35.] — In *Paralithodes camtschatica* the spermatogonium contains 208 and spermatocyte 104 chromosomes, of which none shows behaviour to recall that of a sex-chromosome. In *Gammarus annandalei* the diploid number is 54, and haploid 27, no XY chromosomes being found. The results of previous authors supporting the presence of sex-chromosome in crustaceans require further confirmation.

T. Komai.

719. Biological Significance of Coincidence in Crossing-over. (Japanese.) Hideo KIKKAWA. [Jap. Journ. Genetics, 11, No. 2 (1935), 51–59.] — The problem of coincidence in crossing-over presents a variety of cases for consideration. In general, coincidence between adjacent regions is lower than 1.0. But it often exceeds 1.0 in the middle region of the V-shaped chromosome, in the translocated chromosomes, or, in the ring-formed chromosomes. These facts may be easily accounted for by the assumption of incomplete synapsis or asynapsis. In the case where non-adjacent regions are considered, the gross-coincidence method is more adequate than the usual partial-coincidence method. Thus it has been found that interference is complete to a certain point from the original break, but from that point on, the effect suddenly disappears. From the study of the various cases, the conclusions reached in the previous papers (1932, 1933) are in the present paper somewhat revised. Author.

720. Genetical Studies on Male Intersexes in *Homoeogryllus japonicus* de Haan. (Japanese.) Fumié OHMACHI. [Jap. Journ. Genetics, 11, No. 2 (1935), 89–90.] — The intersex has male gonad and genitalia, and female-like or intersexual wings which it rubs together in erect position; it chases female but no copulation occurs. Two strains have been isolated, one with female-type wings and the other with intersexual wings. Breeding tests up to F_6 have shown that the intersex is produced by the activity of a recessive sex-linked gene. T. Komai.

721. The Chromosome Complex of the Genus *Drosophila* Viewed from the Arrangements of the Genes. (Japanese.) Mitsushigé CHINO. [Jap. Journ. Genetics, 11, No. 2 (1935), 99.] — In the formation of new species in *Drosophila*, mutations in the chromosomes (changes in the arrangement of genes and morphological changes in chromosomes) go parallel with changes in external features. The sex-chromosomes and autosomes had probably been differentiated in the remote ancestor, and have evolved independently for a long period. For species-formation the change in the X-chromosome implies inversion only, while the autosomes may undergo various kinds of changes, of which the most frequent one is inversion and translocation comes next. Consequently, in closely related species chromosome arrangements resemble closely, and remotely related species have very different chromosome arrangements. T. Komai.

722. Investigations on the *pV* Inversion in the Silkworm. Report. II. (Japanese.) Yoshimaro TANAKA. [Jap. Journ. Genetics, 11, No. 2 (1935), 112–114.] — Among the progeny of *Py* ♀ × X-rayed *SY* ♂, unexpected *p* appeared, which showed complete linkage with *Y*. This is probably because the irradiation has caused mutation of *S* gene into *p* and the portion of the II. chromosome including *p* and *Y* has been inverted and prevented the cross-over between the loci. *pV* inversion behaves as a partial lethal and kills a part of the larvae. T. Komai.

723. A Particular Case of Sex-linked Inheritance in the Silkworm. Preliminary Report. (Japanese.) Hisashi NISHIKAWA. [Jap. Journ. Genetics, 11, No. 2 (1935), 114–116.] — Presumably a case of duplication of Z-chromosome. The individuals with this duplication are of low viability and mostly die either in the egg, or in the larval stage; the imagoes also are smaller than normal.

T. Komai.

724. Some Considerations on the Relationship between the True Nucleoli and Sex Chromosomes. (Japanese.) Shinkichi TATEISHI. [Jap. Journ. Genetics, 11, No. 2 (1935), 132–133.] — Cytological observations on the orthopteron *Brachytrutes* and *Rattus* spp. reveal that

the true nucleolus (plasmosome) has a close relationship with autosomes or sex-chromosome in certain stage of spermatogenesis. This probably implies some physiological relationship between the two bodies. S. Komai.

725. On the Taxonomical Significance of Chromosomes in the Genus *Xiphidon.* (Japanese.) Fumié OHMACHI and Chizuo SOKAME. [Jap. Journ. Genetics, **11**, No. 3 (1935), 197 198.] — The senior author has postulated the idea that in the allied subfamilies of the super-family Gryllidae (Orthoptera) the total volume of the chromosomes is nearly constant even if the number is different, and also that the X-chromosome has the same size and form in the allied species. The validity of this idea has been tested in the two species of Xiphidiinae (Orthoptera), *Xiphidion maculatum* and *X. gladiatum*. The chromosome number is 21 and 33 respectively; but the volume of the total chromosome complex is nearly identical. The difference in number is due to the association between two rod-shaped chromosomes which have occurred in the former species. The X-chromosome is nearly identical as expected. T. Komai.

726. A Comparative Study of the Chromosomes in the Indian Dragonflies. Sajirô MAKINO. [Jap. Journ. Genetics, **11**, No. 4 (1935), 234–235.] — The 8 species belonging to Libellulidae which have been studied have all n=13, 2n=25 chromosomes, while *Ictinus rapax* of Aeschnidae has n=12, 2n=23, and *Ceriagrion rubiae* of Coenagrionidae has n=14, 2n=27. All the species have 1 X-chromosome which divides in the first division, but goes to one pole undivided in the second division. One autosome is much smaller than the rest in varying degrees according to different species. T. Komai.

727. Crumploid, a Sex-linked Character of *Drosophila ananassae.* Daigorô MORIWAKI. [Jap. Journ. Genetics, **11**, No. 6 (1935), 302–307.] — A new mutant crumploid (*cl*) appeared in *Drosophila ananassae* from a stock of *ct*. The gene of *cl* is sex-linked recessive with a complex expression affected by certain modifiers. The degree of the expression of *cl* seems to vary from false normal to crumploid with lethal effect. In the male the expression is reduced considerably, resulting in excess of males. There is a linear correlation, rough as it is, between the frequency of crumploid in the female and that in the male. The modifiers are believed to be positive and they could be made to accumulate by means of selection. The locus of *cl* is 91.8±, situated very closely to *ct* in the X-chromosome. Author.

728. *Sinanodelphis izumidaensis*, a New Miocene Dolphin of Japan. Jirô MAKIYAMA. [Mem. Coll. Sci., Kyoto Imp. Univ., Ser. B, **11**, No. 2 (1936), 115–134, 3 pls.] — Description of a new dolphin from the Miocene shale in Sinano. The fossil dolphin which belongs to a new genus of the family Delphinidae is charactcrized by having all the 7 cervical vertebrae entirely free and elongate. The skull resembles that of *Dephinavus* from California in having a high upright occiput which forms a sharp angle with the cranial roof. The teeth are small, simple and uniform and over 40 in number on each side. The rostrum is as long as in *Delphinus*. The neural spines of the thoracic vertebrae are very high unlike those of *Delphinavus*. The manus is very long. The new genus is separated clearly from any other Miocene Delphinid genera by having a closer relationship to the living *Delphinus*. T. Komai.

729. Studies on the Disintegration of *Branchiura* sp. by Methylene Blue. II. Respiratory Quotient and Respiration of Acidified Tissue. S. KAWAGUTI. [Mem. Fac. Sci. Agr., Taihoku. Imp. Univ., **7**, No. 3 (1934), 141–146.] — The O_2 consumption and the R. Q. of *Branchiura sowerbyi* were studied by Dickens and Simer's method employing the Warburg-Barcroft manometer. In 2/1000 % solution of methylene blue the R. Q. decreases with time of experiment. Three dismembered pieces, i. e. head, middle and tail, show the different R. Q. values high at head and tail, low at middle. These R. Q. values, however, decrease with time. The tissue acidified with HCl shows high values both in R. Q. and O_2 consumption. The disintegrated fragments consume O_2 considerably, with very low R. Q. Consequently, it is supposed that there are two phases in the process of disintegration, one of which is represented by the strong respiratory intensity and the high R. Q., and the other by the weak respiration and the low R. Q.

S. Kawaguti—I. Harada.

730. Effect of Oxidation-Reduction Potential Indicators on the Oxygen Consumption and the Respiratory Quotient of *Branchiura Sowerbyi*. S. KAWAGUCHI. [Mem. Fac. Sci. Agr., Taihoku Imp. Univ., **7**, No. 3 (1934), 147–153.] — The effects of a series of oxidation-reduction potential indicators upon the respiration of *Branchiura sowerbyi* were studied by measuring O_2 consumption and CO_2 out-put with Warburg-Barcroft manometer. The E'_0 values of the dyes used ranged from 0.34 to −0.34 volt at pH 7. The experiments were carried out by immersing the animal in 10^{-3} M dye solutions, containing 45, 3 and 5 millimols of NaCl, KCl and $CaCl_2$ respectively and buffered with M/1000 phosphate at pH 7. Excepting the cases with non-permeable and with high toxic dyes, there occurs no effect on the O_2 consumption but an increase of R. Q. in the dyes with very high E'_0, an increase both in O_2 consumption and R. Q. in those with slightly high E'_0, an increase only in O_2 consumption in those with E'_0 corresponding with that of the animal tissue, and again an increase both in O_2 consumption and R. Q. in the dyes with very low E'_0. S. Kawaguti-I. Harada.

731. Zur Acanthocephalenfauna von Japan. I. HARADA. [Mem. Fac. Sci. Agr., Taihoku Imp. Univ., **14**, No. 2 (1935) 7–23, 9 Figs.] — Beschrieben werden *Pallisentis celatus* (van Cleave), *Micracanthorhynchus motomurai* n. g. n. sp., *Rhadinorhynchus trachuri* n. sp., *Corynosoma ambispinigerum* n. sp., *Bolbosoma thunni* n. sp., *Acanthocephalus lucidus* van Cleave, *A. echigoensis* Fujita, *Spirorhynchus alemniscus* n. g. n. sp. (Spirorhynchidae n. fam.) und *Macracanthorhynchus hirudinaceus* (Pallas), mit nachträglicher Notiz über *Corynosoma osmeri* Fujita. I. Harada.

732. Studies on the Seed-corn Maggot. II. Chukichi HARUKAWA and Saburo KUMASHIRO. [Berichte des Ohara Inst. f. landw. Forsch., **5**, Hft. 3-4 (1932–33), 457–478] — The insect is found all the year around in any stages of the development; the egg, the larval, the pupal and the adult stage. But the adult flies are most abundant in March, April and May and are very scarce in July, August and September. The second abundance comes in October and November, but during this period the flies are markedly lesser than at the first period of the greatest abundance. Winter is passed in any of the four stages of the insect. When adult hybernates it enters in crevices in the soil or in other protected places, and after this period the fly lays eggs. The duration of egg period is 85 days at the temperature of 9.7°C. The larva from the egg in the middle of July requires from 18 to 19 days to attain the adult stage at the mean temperature about 25°C. Individual from the egg which was laid at the end of the November or the beginning of December requires markedly long time to reach the adult stage, roughly 130 days in most cases. N. Yagi.

733. Studies on the Seed-corn Maggot. III. On the Method of Control of the Seed-corn Maggot. (1). Chukichi HARUKAWA, Ryoiti TAKATO and Saburo KUMASHIRO. [Berichte des Ohara Inst. f. landw. Forsch., **5**, Hft. 1 (1932–1933), 83–111.] — Experiments were carried out to find an effective method of control of the seed-corn maggot, *Hylemia cilicrura* Rond. Submergence in water was not effective in controlling any of three stages. Mixture of pyrethrum and soap solution, emulsion of kerosene extract of pyrethrum, cresol soap, desin, neoton derris soap, nicotine sulphate, lime-sulpher, tobacco powder, mixture of tobacco and wood ash, also that of pyrethrum and wood ash, leucothoe powder and mixture of leucothoe powder and wood ash were tested in the laboratory to test whether these are effective for killing the egg, larva or pupa which is found in the soil. A few of them were fairly effective when they were tested at a highly concentrated state, but they were injurious to soy-beans and could not be used for practical purpose. Goto's desin was most effective to kill the egg of the maggot when it was used at a dilution 1/50, but it was injurious to the soy-bean at that concentration. The larva could not be killed by this solution. The larva is killed by burying it for several days in soil which was saturated with the emulsion of kerosene extract of pyrethrum diluted to 10 times the volume of the stock solution. But it is doubtful whether it can be employed practically. For the trapping method, the solution of ammonia and alcohol were tried and they were effective to attract the adult as human excreta does. Ethyl butyrat, methyl butyrate and methyl acetate did not increase the attractivness of alcohol. Dried pupa of the silk worm and cotton seed meal were more attractive than either alcohol, ammonia, human excreta, or alcoholic solution of esters. For the method of preventing the oviposition of adult fly, the mixture of pyrethrum and wood

ash, that of tobacco powder and wood ash, and also that of naphthalene and wood ash, were effective when sufficiently large amount of them were strewn upon the field. Creosote oil emulsion and mixture of creosote oil and fine sand, and also that of coal-tar and fine sand, had a marked effect of preventing of oviposition. N. Yagi.

734. Studies on the Seed-corn Maggot. IV. Chukichi HARUKAWA, Ryoiti TAKATO and Saburo KUMASHIRO. [Berichte des Ohara Inst. f. landw. Forsch., **6**, Hft. 2 (1934), 218-253.] — The foods of the seed-corn maggot are mentioned as follows adding to the foods ever reported. From living plants; *Chrysanthemum coronarium, Daucus carota, Arctium Lappa, Allium cepa, A. nipponicum, Rumex acetosa, R. japonicus, Trifolium pratense, Taraxacum platycarpum, Equisetum arvense, Artemisia vulgaris, Nasturtium sublyratum, Oenanthe stolonifera, Cryptotaenia canadensis, Spinacia oleracea, Zea Mays, Cyperus rotundus, Zizania aquatica, Physalia Alkekengi, Colocasia antiquorum, Mentha arvensis, Pirus sinensis, & Musa paradisiaca.* From dried Plant substances; soy-bean cake, rape-seed meal, cotton-seed meal, rice bran and wheat flour mixed with water. From animal substances; dried pupae of the silkworm, dried fish, dead insects, eggs of a locust and dead tadpoles. From the other substances; horse manure and fowl manure. The longevity of the adult in summer varies from 2 or 3 to 30 or 40 days, while in winter it is at least 12 days and it reaches as much as 120 days. The preoviposition period of the fly varies according to the season, being long during the cool months of spring and autamn and short during the warm months of summer. In December and January it varies 20 to 60 days and in May and June from 5 or 6 to 16 or 17 days. The egg can develop under a pretty low temperature even at a constant temperature of 10°C., 90 per cent hatched while under a constant temperature of 12° to 33°C. nearly all hatched. At a constant temperature of 35°C., only 30 per cent hatched. About 90 per cent of the larvae and pupae developed at a constant temperature of 12°C., and at 33°C about 80 per cent of the larvae pupated. When larvae were reared at a constant temperature of 35°C. all died. At a constant temperature of 33°C. only 40 per cent of the pupae developed and at 35°C. all pupae died. The egg period was 8 days at 10°C. and only one day at 30°C. The development of egg was most rapid at 30°C. The threshold temperature of the egg development is slightly above 35°C. The larval period was 30 days at 10°C. and 5 days at 30°C. The development of the larva was most rapid at 30°C. The threshold temperature for the larval development was found to be situated between 33°C and 35°C. The pupal period was 50 days at 10°C. and 7 days at 33°C. and its development was most rapid at 33°C. The threshold temperature for pupal development lies between 33° and 35°C. Pupae sometimes entered a temporary dormant state when they were reared at low temperature as 10° or 12°C. The whole length of time from oviposition to emergence of adult insect was about 85 days at 10°C., 24 or 25 days at 20°C., and 16 or 17 days at 25°C. Adding to these figures, the duration of the life cycle of the seed-corn maggot becomes about 100 days during winter and 21 or 22 days during the early summer. The effect of the moisture content of the soil on development of the larva and pupa was remarkable according to the experiment, the larva and pupa could not develop in a very dry soil. N. Yagi.

735. The Toxic Action of Certain Chemicals on Aquatic Oligochaetes. Chukichi HARUKAWA. [Berichte des Ohara Inst. f. landw. Forsch. **5**, Hft. 3-4 (1932-33), 447-456.] — The toxic action of potassium nitrate, potassium hydroxide and calcium hydroxide on the Brachiura and Limnodrilus species was examined in the laboratory and in the field. Potassium hydroxide is more highly toxic to Brachiura than potassium nitrate. But according to the strong alkalinity of the former it will be unsuitable for application in the rice field. The toxic action of calcium hydroxide to Brachiura is very strong under laboratory conditions, but it is not so strong when mixed with the soil in the rice field. N. Yagi.

736. Heat as a Means of Controlling the Angoumois Grain-moth. I. Chukichi HARUKAWA and Saburo KUMASHIRO. [Berichte des Ohara Inst. f. landw. Forsch., **6**, Hft. 3 (1934), 393-406.] — The experiment is conducted to control the all stages of the moth by heat. The egg is most susceptible to high temperature and can be killed by exposure for 5 minutes to 60°C. The larva and pupa are more resistant than the egg and 100 % can not be killed unless they are exposed to 60°C for 1 to 1.5 hours. As the temperature is raised, the duration

of exposure which is required becomes gradually shorter, and at 80°C, only 15 to 20 minutes exposure is required to kill almost 100%. Germinations of wheat and barley thus treated are normal, if the seeds are well mature and dry. N. Yagi.

737. **Studies on Fumigation with Chloropicrin.** Chukichi HARUKAWA and Saburo KUMASHIRO. [Berichte des Ohara Inst. f. landw. Forsch., **6**, Hft. 3 (1934), 407–430.] — Angoumois grain-moth are killed by chloropicrin fumigation on them at any stages. The eggs can be killed by exposing for 48 hours with a dosage of ¼ lb. per 1,000 cubic feet. Larvae and pupae are killed in 48 hours with at least ½ lb. per 1,000 cubic feet. When the fumigation box is full of grains, the gas diffusion is greatly retarded and the percentage of insects killed diminishes markedly with the increase in thickness of the wheat layer. At a depth of 5 feet below the surface, a very small percentage of the full grown larvae is killed by fumigation for 96 hours with a dosage of 2 lbs., per 1,000 cubic feet. When the fumigation box is provided with a passage for gas diffusion, 93 to 99% of all the stages of the moth can be killed by fumigating for 72 hours with a dosage of from 1½ to 2 lbs. of chloropicrin per 1,000 cubic feet. If the air temperature is as high as 27°C nearly the same result can be obtained by fumigation for 72 hours with 1 lb. *Calandra oryzae* were fumigated also with chloropicrin. The adults were killed nearly 100% by fumigation for 72 hours with 1 lb. of chloropicrin per 1,000 cubic feet when temperature was above 22°C. Barley seeds are more susceptible to the gas than wheat, the germination of the former is reduced by 20 to 30% by fumigation at the above condition, while the latter is almost uneffected by the same treatment, if it is fumigated after the end of July.
N. Yagi.